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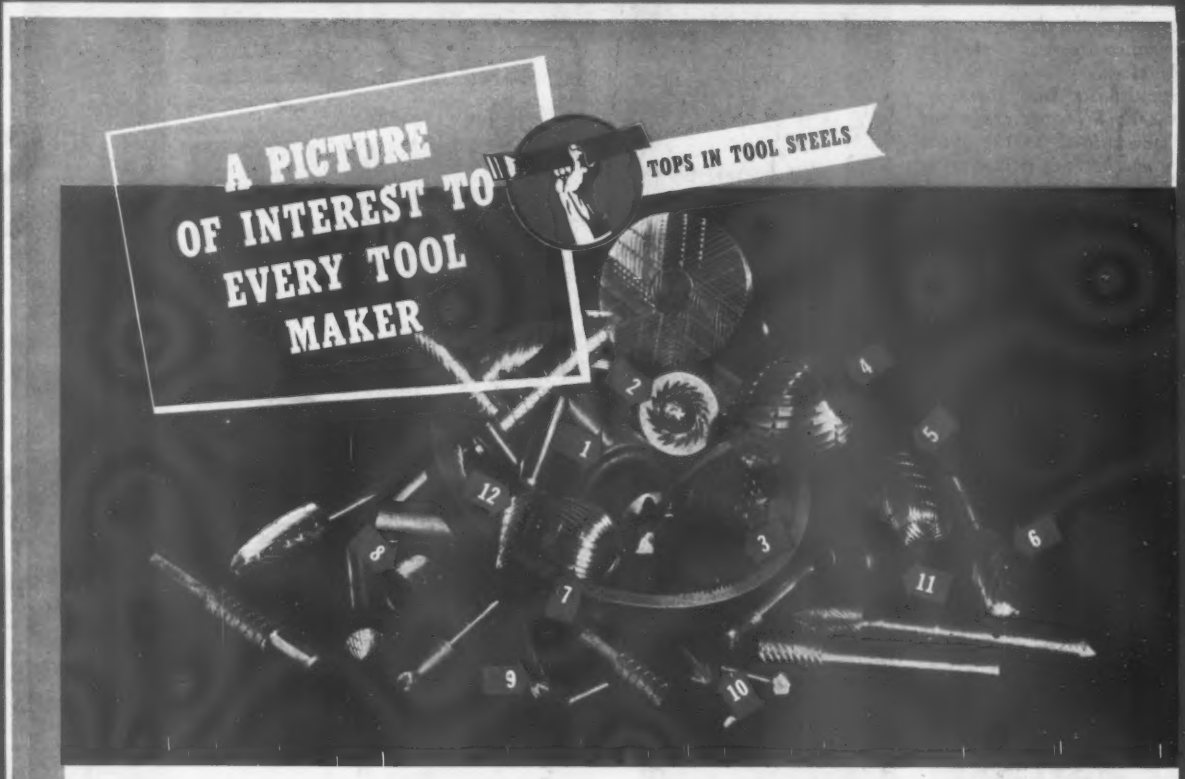

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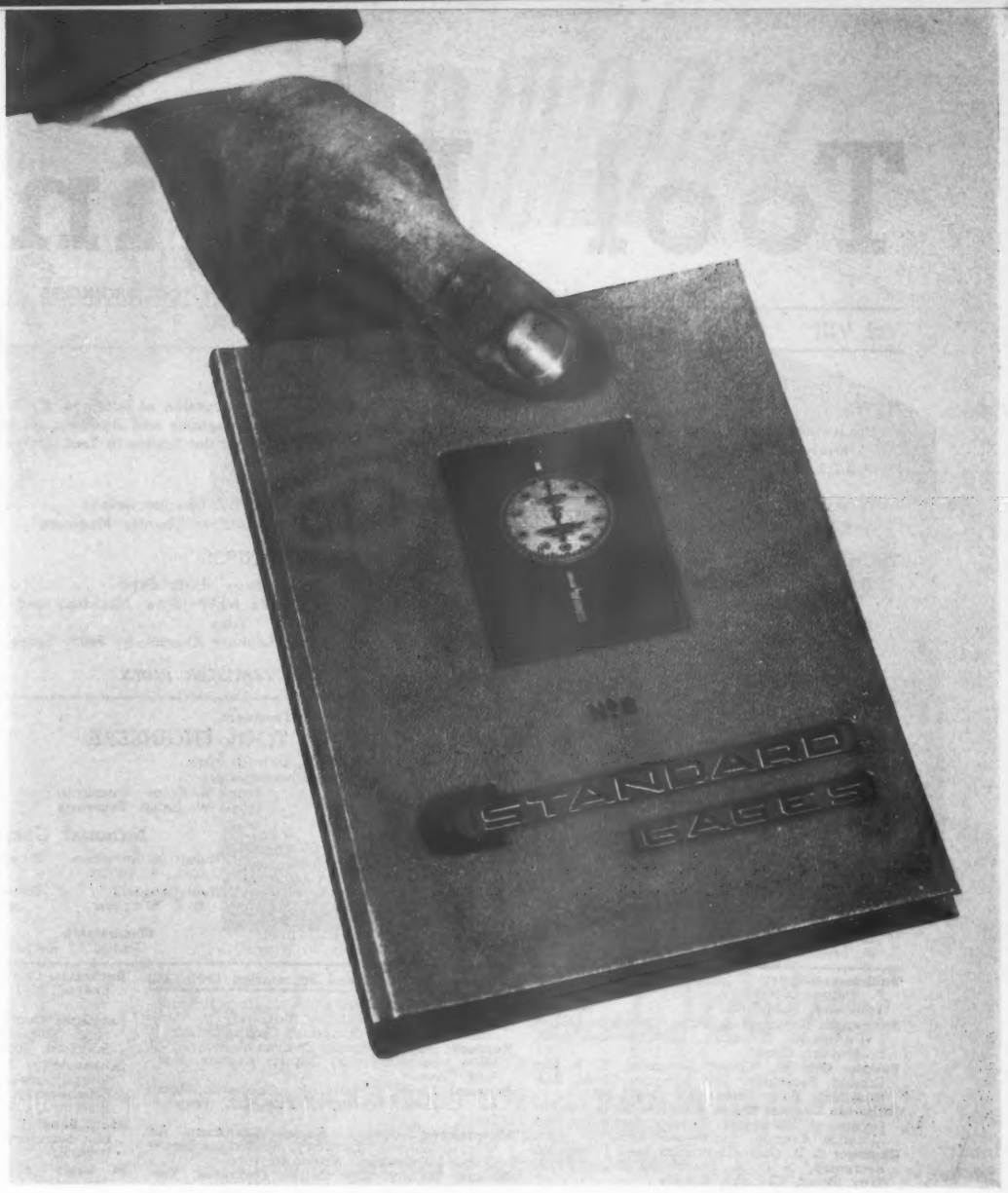

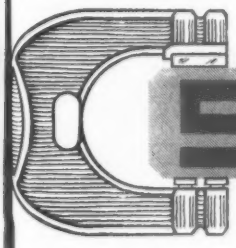

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Vol. VIII DECEMBER, 1939 No. 8

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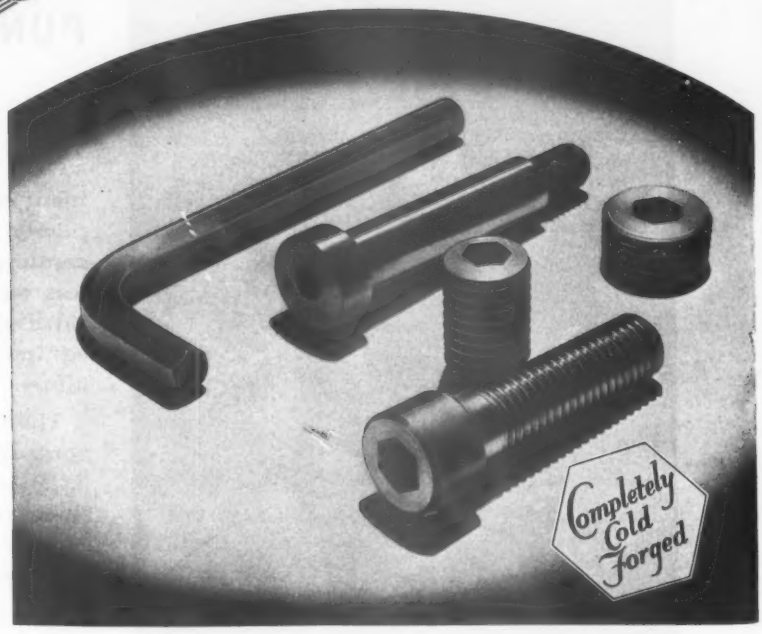

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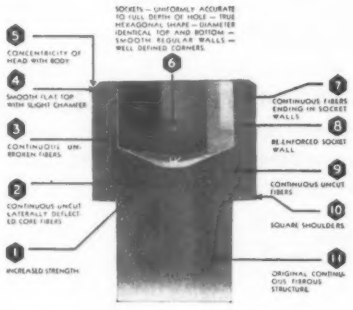
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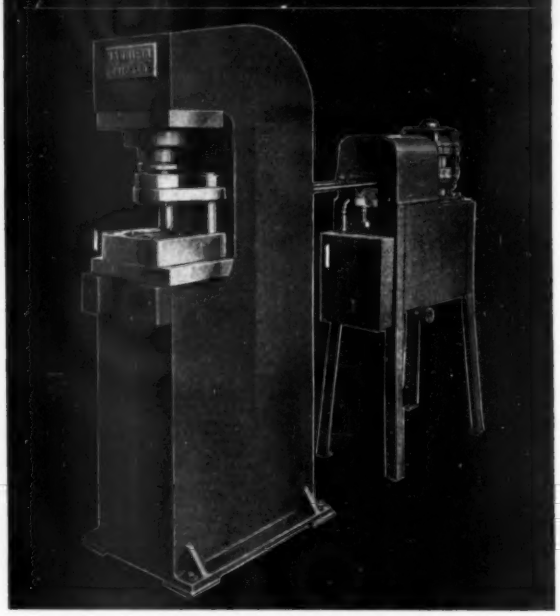

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KEY MEN IN WAR

AN EDITORIAL
By
A. E. RYLANDER

WHEN, IN 1914, THE "SHOT HEARD 'ROUND THE WORLD" precipitated a World War beyond the powers of diplomats to stem, the blueprint became one of the most important mediums of communication between the allied belligerents. It spoke a universal language, needed no decoding, and largely swayed the issue in favor of the Western Allies. From parts prints, American Tool Engineers designed tools for the production of munitions and the equipment of war. Methods evolved in the emergency all but revolutionized peacetime mass manufacture. The key men in industry, Tool Engineers are also the key men in time of war.

This fact is brought home to us in the reading of accounts of two A.S.T.E. Chapter meetings, when United States Ordnance Officers addressed large membership gatherings. A neutral at date of writing, our government nevertheless initiates educational programs for a possible "M" day. Profiting by the bitter lesson of previous unpreparedness, America now prepares with a foresight and thoroughness that bodes disaster for any possible future enemy. And logically, looks to the Tool Engineers to repeat the achievements of a previous test of arms. For, in the final analysis, the fit of a shell into a gun, the smooth functioning of a torpedo, with its intricate, precision mechanism, the production of arms to interchangeable precision, is each as vitally important to Army and Navy as the men who use them. For precision means dependability; master mathematicians who plot ranges are backed by master technicians in tooling who meet the most exacting demands. That is a coordination that insures national integrity.

Speaking for ourselves, we would rather tool the products of peaceful commerce; as a body, we are committed to construction, not destruction. We work with other engineering bodies to promote industrial safety, to supply comforts and luxuries, to enhance civilization. We deplore the speeding shell that, indiscriminately, destroys mellow objects of art and cherished homes as well as military objectives; in our hearts we have only a deep and abiding pity, not hatred, for the unfortunates who are drawn into the cauldron of war. But, should we be drawn into war, then we must coldly submerge our finer instincts under an equally cold determination to effect a quick and decisive victory. Then, a calculating coldness would be the essence of mercy.

We believe that we are prepared to meet the demands of any emergency that may develop. In the machine tool industries, factories are working night and day to fill orders, many concerns quoting '41 deliveries. Aircraft builders are hiring thousands of men to fill foreign as well as domestic orders for ships, the while engineering ingenuity evolves the super-machinery of the future. America prepares, is ready to produce the munitions of peace or war, as the case may be. And, the Tool Engineer stands as the key man in the scheme of mass manufacture.

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APPLICATION and USE of ANTI-FRICTION BEARINGS as APPLIED to MACHINE TOOLS

By STANLEY R. THOMAS
CHIEF ENGINEER
BANTAM BEARINGS CORPORATION
SOUTH BEND, INDIANA

In selecting bearings for machine tools, two courses are open to the designer. He may leave the problem entirely in the hands of the bearing manufacturer, or he may acquaint himself with the subject of bearings to an extent where he will be conversant with their general characteristics.

It will be our attempt, therefore, to cover in a general way as much of a large subject as time permits, confining our remarks as far as possible, to those bearing types applicable to machine tools.

Principle of Operation

Slide 1

THE principle upon which all anti-friction bearings operate is briefly as follows: Let us take a radial roller bearing of either the full complement or the cage type. It will have an inner and an outer race between which are interposed rollers, which in the case of the full complement type may lie adjacent to each other, or in the case of the cage type, be mechanically spaced by the cross bars of a cage. Let us assume the outer race is held in a housing, the inner fitted to a shaft revolving clockwise with a constant downward load on the shaft.

Analyzing the action of a single roller as it follows its path, we find it rolling into the load zone at an angle of approximately 36° from the vertical in the lower right hand quadrant. As it advances downward toward the lowest point of the bearing its load increases until it reaches a maximum after which it decreases until a point is reached approximately 36° past lower center, when it passes out of the load or work zone.

At the time this roller enters the load zone it is round, but as it travels further into this zone and since it is of a perfectly elastic material, it progressively flattens between its loaded contacts assuming a constantly changing elliptical section as it rolls toward the point of maximum loading, the short axis of the ellipse gradually lengthening as it leaves the point of heaviest load until it again becomes cylindrical. The roller after leaving the load zone, then enters the vacation zone where it merely rolls without load, through an angle of approximately 288°. The races also deflect under pressure exerted by the rollers. This principle applies also to the tapered roller and ball bearing.

The foregoing is substantially correct and will do for purposes of illustrating the action of the rolling members. It will be seen, therefore, that as the rolling elements flatten slightly under the loaded side of the bearing, a minute increase in diametral clearance takes place. Rollers in their vacation period then adjust themselves to correct alignment before again entering the load area.

The tendency of the roller to stray from its predetermined path is due to many causes such as slight machine and housing inaccuracies, out of roundness, taper and shaft deflection. If the work requirements are such as to demand absolute freedom from radial play, the use of precision bearings with slight preload sufficient to offset any possibility of radial play under load is indicated.

Slide 2

The condition under which the thrust bearing operates is quite different. Whether it be a taper, a straight roller, or a ball thrust bearing, all of the rolling elements theoretically carry equal loads at all times. Due, however, to inaccuracies, such as, misalignment, manufacturing tolerances, etc., no matter how slight, it is doubtful if this is ever the case. For this reason we rate the capacity at approximately two-fifths of its computed value although many heavily loaded bearings in the field would substantiate the use of three-fifths.

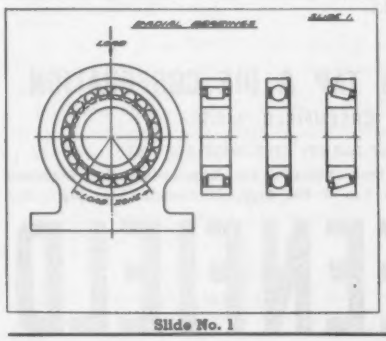
Basis of Capacity

Slide 3

The capacity of a roller or ball is based upon its ability to withstand certain stresses well within the elastic limits of the material itself. After determining the load on the heaviest loaded roller of, for instance, a radial roller bearing, we find its line contact such as exists in the vacation zone becomes a contact of measurable width or a rectangle. The safe average pressure over this rectangle of contact is easily computed from laboratory tests and from practical results in operation. This determines the capacity of the bearing. In the case of the radial ball bearing with grooved race, this area becomes an ellipse. It is understood, of course, that we are dealing with ground surfaces of a structure and hardness suitable for anti-friction bearings, this hardness lying in the neighborhood of Rockwell "C" scale 60.

The safe stress over the contact area has been arrived at by numerous experiments and has been verified by many thousands of anti-friction bearings operating successfully.

It is apparent then, that a roller or ball under a safe static loading will carry its load indefinitely. This leads us to the reason for decreasing bearing capacity ratings, as the R.P.M. increases. The frequency, with which the rollers or balls are loaded and again unloaded has a direct bearing on the expected life of the assembly and thus load ratings are adjusted accordingly. Although we have confined our remarks so far to the rollers or balls themselves, equal consideration must be given to the load-



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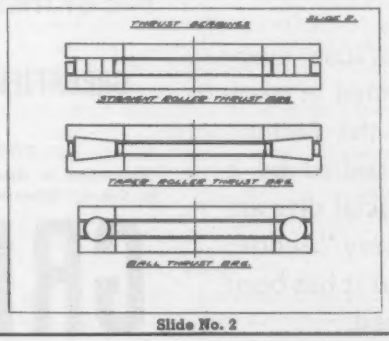

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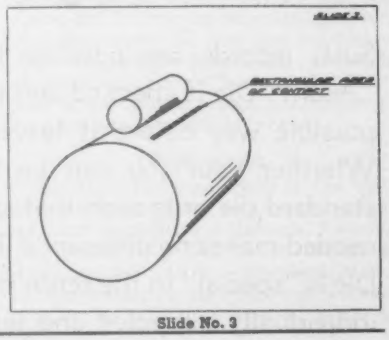

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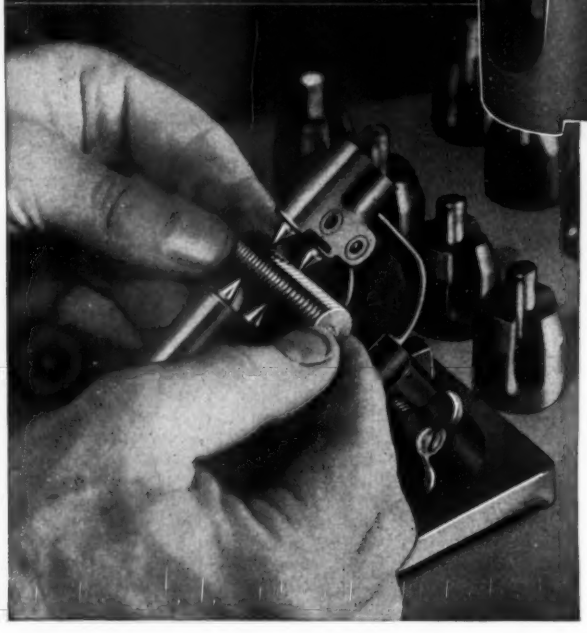

THESE ARE FACTS

540 threaded parts per hour, 4320 per day, day after day for nearly fourteen 40-hour weeks. Over three months of steady work by one single die! That is the record of an "Acorn" Die cutting .098–100" brass screws with ¼-inch of thread. Moreover the threads have to be "right" in every way as they are gage-checked for size and optically inspected for appearance and finish. The customer thought he was "cutting it fine" when he bought only 3 dies, but after three months' operation he hasn't even unwrapped two of them!

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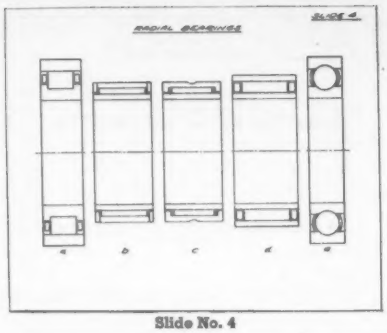

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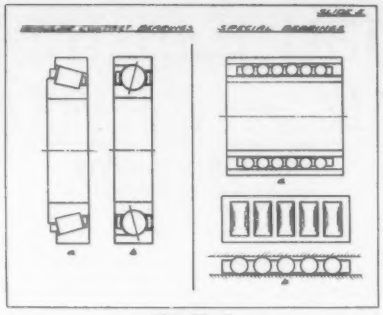

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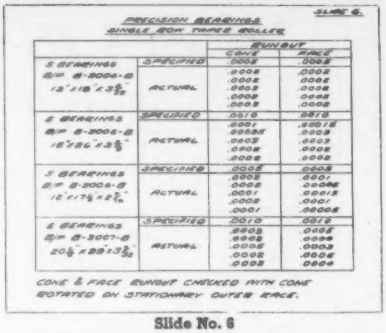


Slide No. 6

ing and unloading taking place over the work area of the stationary race. In order that long life is assured, speed factors are applied which progressively modify the load ratings as the speed increases.

Another factor which is often overlooked in choosing a bearing, particularly from catalogs, is the installation and service factor. Such factors must be taken into consideration as they insure the bearing against several discrepancies that may exist. These may lie in housing and shaft diameters, in the nature of the load whether steady or subject to shocks, in the alignment or deflection of parts, or in the means and frequency of lubrication. The safe stress computed for the area of contact of a loaded ball or roller is considerably under the stress which would be imposed by a load capable of actually Brinelling the materials in contact.

Types of Anti-Friction Bearings Applicable to Machine Tools:

The following are some of the usual types of anti-friction bearings applicable to machine tools.

Slide 4

1. Under Radial Bearings, we have—

(a) Full complement type with lip guided rolls, or cage type with lip guided rolls, the latter shown.

(b) Full complement without retained rolls. (Needle)

(c) Full complement with end retained rolls. (Quill)

(d) Gage or journal type.

(e) Radial ball bearings.

Slide 2

2. Under Thrust Bearings may be listed—

(a) Straight roller.

(b) Taper roller with or without cage, cage shown.

(c) Ball with grooved or flat races, grooved shown.

Slide 5

3. Under Angular Contact Bearings capable of radial and thrust loads we have—

(a) Taper roller bearings, lip guided, with or without cage, cage type shown.

(b) Angular contact ball bearings, cage or cageless type, cage type shown.

4. Finally Special Bearings—

(a) Ball reciprocating and rotating.

(b) Ladder, roller type.

Bearing Speeds

Safe allowable speeds of various types of bearings vary greatly. The speed of the full complement type is often, in the larger sizes, limited by noise. The introduction of a cage reduces the peripheral rubbing speed by 50% and therefore cage equipped bearings in general may attain much higher speeds. The above does not apply to the small diameter needle bearings in which the rollers are of comparatively light weight and the clearance between them relatively small.

Pitch line speeds in the neighborhood of 1,500 feet per minute are common, although a number of installations are exceptional in that they function at several times this figure. Of course, special provision must be made to insure successful operation at these high speeds and such problems should be laid before the bearing engineer.

We cite a small full complement needle bearing that has been running on an arbor at 50,000 R.P.M. The needle and shaft diameters are 1/16" and 7/16" respectively. The pitch line speed computes 6,250 feet per minute, and in three years of daily operation, wear has been almost negligible.

Another outstanding example of deviation from practice is that of a taper roller bearing running on a spindle in conjunction with a straight radial roller bearing that has run for several years with a pitch line speed of 5,500 feet per minute, this same installation having previously undergone tests at speeds up to 7,500 feet per minute. Still another example is that of a straight roller thrust bearing of 25" OD which has been operating for many years with a pitch line speed of 2,620 feet per minute.

Lubrication

For most types of anti-friction bearings, lubrication is not of a critical nature. Grease is most commonly used for the smaller bearings operating at low to medium speeds, principally because it has the advantage of remaining in the bearings for a considerable length of time and to a certain extent offers protection against foreign matter finding its way into the working parts.

There are, however, very definite requirements for fluid types of lubricants for use in connection with bearings operating at high speeds. Of course, proper seals must be provided for the retainment of fluid oils.

Wear

In a properly designed anti-friction bearing, wear becomes a negligible factor, and it is for this reason, that although the first cost is generally higher, maintenance costs are practically eliminated, so that over the life of the machine, an economy, not often at first realized, is effected.

Accuracy and Degree of Precision

Nearly all bearings are specified as, standard, precision or ultra-precision, and the degree of precision naturally affects their cost.

Slide 6

We have prepared a slide comparing precision limits with inspection records of a representative lot of precision bearings, lately manufactured for a large machine tool builder. You will note that even in these large sizes, actual face and radial runout are considerably less than the allowable limits.

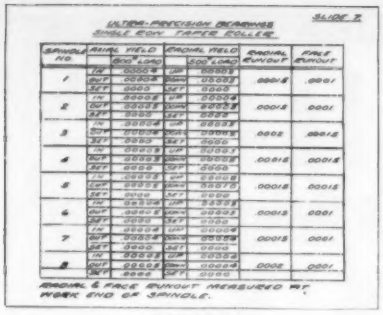
A few years ago an ultra-precision bearing might be one of ten built in an attempt to meet the extremely close limits of that type of bearing. Today ultra-precision bearings are built as a regular procedure and so successfully that we find the specifications in most cases allow 50% wider limits than those to which these bearings actually measure. The limits for radial runout of each race and face runout of either race for the precision bearing is .0005", but these are daily being cut in half, not only in the smaller bearings, but in the larger 26" to 30" sizes of straight and taper roller bearing assemblies. The same limits for the ultra-precision bearing in 26" or 30" size, usually are .0005, but can be held to .0001" if requirements justify the added cost.

Slide 7

Another chart shows the results obtained by measurements taken at the work end of a spindle mounted in ultra-precision bearings under load. These measurements were taken by the machine tool builder on his actual machine and here again all bearings fall inside their allowable tolerances although measurements were taken at the work end of the spindle where multiplication of error would naturally be read.

Applications

Although there no doubt is one type of bearing best fitted for each individual position throughout a machine, it would be exceedingly difficult to set up a hard and fast rule to be followed. Many factors influence the choice of a bearing for an individual location, some of



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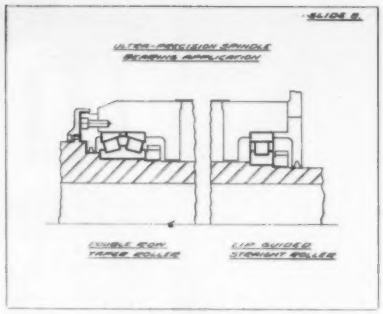

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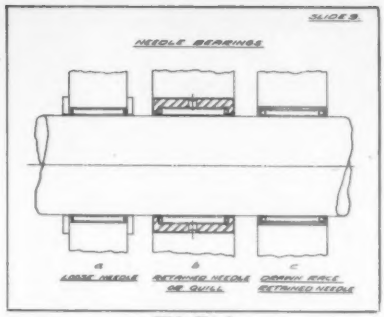

Slide No. 9

which are: 1st, the requirement for accuracy; 2nd, the method of assembly; 3rd, the room available; 4th, type of lubrication; 5th, loads and speed; 6th, requirement for adjustment; and 7th, cost.

There is one thing, however, that will divide all types of bearings into two general classes. This is whether the particular type of machine into which the bearing is to be fitted, requires its shaft to operate without any play or relative radial motion between races.

Should the requirements be that of no play, then the following bearings may be used:

(A) Radial with lip guided rolls whose roll lengths do not greatly exceed two roll diameters.

(B) Radial ball bearings.

(C) Double-row taper roller bearing.

(D) Angular contact ball bearings, two-row.

(E) Ball reciprocating and rotating.

All of these will run with zero diametral clearance or with light preload.

For accurate table and spindle bearings of from 8" and up, precision or ultra-precision of either two-row taper or angular contact ball bearings are recommended. In table bearings where the weight of the table is sufficient, a single taper may be used directly under the table with means provided below to maintain axial alignment and prevent rise of the table. Examples of machines to which these bearings are ideally suited are large indexing tables, rotary surface grinders and rotary boring mill tables. Examples of locations on spindles where the ultra or precision bearings are required are: Gear generating and checking equipment; work head in bore grinders, or in any grinder where the work is mounted on a face plate or chuck; precision turret lathe spindles and in heavy type milling and boring machine spindles.

You are constantly designing and building new machine tools and are, therefore, familiar with many other potential applications for ultra-precision bearings to such machines.

Slide 8

Where heat conditions are such as to produce expansion or contraction of the spindle, so that a spacing of two taper bearings would effect their clearance then a design as shown is recommended. A double-row of two single taper bearings is placed adjacent to each other at the work end and the bearing at the opposite end of the spindle is a straight cylindrical lip guided radial, all to precision specifications. The spindle is free to change length without in any way affecting the accuracy of the work.

Small spindles operate very satisfactorily on ball bearings, the type of bearings specified depending entirely upon the requirements for accuracy. For light radial and heavy thrust loads it is often advisable to use a separate ball or roller thrust bearing. The advantages are apparent. Less power is required during driving and much less for starting.

Slide 9

It is often necessary to lay in a bearing where room is at a premium. Here the quill or needle bearing with its high radial capacity proves valuable, providing, of course, that the requirements of the machine will allow a small diametral clearance in the bearings. This diametral clearance is necessary for the successful operation of this type of assembly.

There are a great many spindles operating where this play is of no consequence as it seldom exceeds .002". Loose needles are ideal for high capacity bearings where natural races exist. (a) By this is meant the ground bore of a machine part such as a gear, and a shaft, both hardened. With hardened end washers and a few cents worth of needles, an excellent bearing results.

No better example of this type of bearing exists, than the several millions of automobiles and trucks operating daily that carry their transmission countershaft gears, their idler gears, and main shaft pilots on loose needles. Nearly every make of American automobile and many trucks depend upon these low cost loose needles, not only in their transmission but in many other locations. These needles are available in all sizes.

Where it is not economy to harden either the part acting as the outer race or the shaft, it is practice to supply either or both parts with a hardened and ground sleeve.

Where a machine, due to assembly, or for other reasons, requires a needle bearing with self-retained needles, the so-called quill bearings are available. (b) These bearings are stock items carried in many sizes and will operate in both horizontal and vertical positions. This is due to the fact that the end flanges or lips in contact with the ends of the needles are ground and cause negligible drag in the vertical position. Such bearings, as well as the loose needle type, supply excellent mountings for multiple spindle idler gears and drive end bearings.

The needle bearing serves in many applications in oscillation as it does not depend upon an oil film. It will function successfully under what is probably the most difficult of conditions, namely where the load is oscillating and is applied to one side of the bearing only.

Small bearings of this type are capable of carrying loads often greater than is safe for the shaft upon which they operate. With hardened inner and outer races the needle bearing will, at 100 R.P.M., carry a load in pounds equal to 7,700 times its projected area in square inches, this area being the product of the effective roller length and the pitch diameter.

Another interesting type of bearing, (c), that may be used in almost any position where bushings are used is one in which the outer races are made from stampings with walls of relatively light section, which together with the retained needles occupy very little room. They are of great value in eliminating friction in many locations in machine tools and not only have remarkable capacity in oscillation, but are also capable of high rotative speeds. A quarter of a million of these needle bearing assemblies are now operating successfully in the machine tool field in various locations. They are being used in electric drills, in gear reduction heads, in machine tool idler gears, in control shafts, and many other places.

They are naturally lower in capacity than the quill bearing, averaging a little less than one-half of its capacity. They may be used directly on shafts of Rockwell "C" 50 hardness for their maximum load carrying ability. For light loads they are often used directly on unhardened shafts.

They are built with lip bores closely fitting the inner race or shaft thereby eliminating dirt to a great extent. They retain lubricant for long periods of time and are serving in many locations without seals.

A cam follower of high capacity, due to its full complement of needles, is available in many sizes. These units are

(Continued on page 28)

APPLICATION and USE of PLAIN BEARINGS as APPLIED to MACHINE TOOLS

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THE subject of Plain versus Anti-friction Bearings as Applied to Machine Tool Spindles has been very controversial during the past few years, and as time goes on, there is seemingly a trend toward the use of anti-friction bearings and the almost complete elimination of plain bearings.

The prime object of this paper is for the purpose of eliciting discussion of the subject, for a frank interchange of ideas, to the extent that such a discussion may throw more light and information and give it just consideration and the recognition it deserves. It is not my intention to present this subject from the standpoint of bearing mathematics, or to in any way enter into the technical phase of the subject. It is my intention, however, to view this subject from the standpoint of the production man and the Tool Engineer—where the successful operation is of most vital concern.

In the time alloted for presenting this subject, naturally it will be impossible to cover all varieties of bearings since an infinite diversity of conditions prevails. It is hoped that enough data can be submitted which will bring about more thought and study to the application of both types of bearings.

High Speed Cutting Alloys Had Their Effect

It might be well to go back a few years in the history of machines and cutting tools; situations which will serve to lead up to the problem at hand. Prior to the introduction of High Speed Steel by Taylor and White, there was not a great deal of concern as to how machine tool spindles were designed. Each designer had his own ideas and they were generally accepted in industry as being quite satisfactory. The introduction of high speed steel, however, brought forth higher speeds, increased tool pressures, which were readily recognized by the machine tool manufacturerers, and machinery therefore began to take on new designs, dimensions were increased, and we heard the words "Improved" and "Heavy Duty" quite frequently applied.

With the introduction of Stellite, greater demands on speeds, feeds, and rigidity were imposed, which called for further development of machinery in order to take full advantage of Stellite tool possibilities. Here again weights were increased, better materials were used, and dimensions were increased to bring about the objectives sought in the use of faster cutting materials.

The introduction of Tungsten and Tantalum Carbide tools brought about numerous new problems and introduced new trends in design, speeds, feeds, etc., in order to take full advantage of the cutting possibilities of this type of tool. During the time of the development of machines to suit the improved cutting materials, lubrication was a factor which was given more attention as to its importance in the successful operation of machines. The oil refineries were developing lubricants with greater film strength and toughness to sustain greater loads imposed by the increasing cutting tool pressure. These improved oils permitted closer fitting of the projected areas in plain bearings and also improved their cushioning and dampening properties. Metals were likewise developed to meet the new conditions and problems. The oil can was almost abolished and in its stead centralized lubrication was widely incorporated. But just prior to the developments in lubrication and bearing metals, we heard a great deal about maintenance to machinery for lack of lubrication and was one of the most common causes of bearing failure. There seemed to be a very slow development in centralized application for the continuous lubrication of all parts and this lack of development drew more forcibly the trend of the application of anti-friction bearings. In some instances it seemed to be the easiest way out for the designers to adopt anti-friction bearings, because it eliminated what seemingly was a difficult problem in oil distribution as well as the scraping and lining up of bearings.

The Trend to Anti-Friction Bearings

Since 1924 there has been a pronounced trend towards the adoption of anti-friction bearings—not only throughout the entire machine, but particularly the spindle.

Right here I would like to point out that the term "anti-friction" is, in my opinion, a misnomer. Where it got its name from, I do not know. No anti-friction bearing is completely free from friction. If it were, no lubrication would be necessary. Contrary to a plain bearing, an anti-friction bearing does not support its load by means of an oil film. It is supported by metal-to-metal contact of the rotating elements of the bearing.

Plain bearings are just as much anti-friction as ball or roller bearings. Any type of bearing is an anti-friction machine tool element and its purpose is to maintain rotating and stationary parts in proper relative position effectively.

Let me say at the outset that I am a firm believer in both types of bearings, when used in the proper application. I further believe that the anti-friction bearing manufacturers have contributed to the development of machine tools tremendously and there is no question but when these bearings are used in their proper place that the benefits derived have been of great value in manufacturing operations. There has been a tendency, in my opinion, to overestimate and to become over-enthused with the application of anti-friction bearings to the extent that plain bearings have been neglected, and due consideration for their extended use has been overlooked.

I belong to that group of Tool Engineers and production men who are mostly concerned with what comes off a machine, passed by the inspector, and does it continuously day in and day out. It matters not whether a machine has a plain bearing, an anti-friction bearing, or even a wooden bearing, so long as it does its stuff day after day without frequent interruptions and delays from any cause.

Today's Demand on the Machine Tool

Today's production and today's engineers are demanding more and more from equipment and the tools used thereon. In response to this demand, machine tool manufacturers and production men are constantly seeking better performance in the machine tools to withstand the more severe service conditions imposed. The machine tool manufacturer and the user of the machine have a joint interest in developing and designing bearings that will render satisfactory service.

Quite frequently some machine tool builders are heard to remark that unless their machines are equipped with anti-friction bearings that it would be impossible to sell them. When confronted by such a general statement, unsupported by facts and data, one might, with all honesty and sincerity of purpose, ask the question, "Who determines this attitude?" Is it the users, the production men and Tool Engineers, or is it by some hide-bound hallucination which has forced the trend of thought without due consideration for either type of bearing.

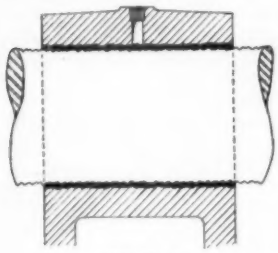
Two of the most destructive forces to present day cutting tools with all types of machines are vibration and chatter. This, every Tool Engineer and production man readily understands. The effects are well known, that even the minutest chatter or vibration has a more pronounced effect upon the cutting action and the life of a tool than any other cause. One of the main objectives in the designing of any machine tool is to eliminate vibration and chatter. The use of Carbide Tools demands almost complete freedom from vibration and more rigidity than that required for any other type of tool.

It has been claimed by some production men that the cost of cutting tools during the life of a machine tool is

much more than the original cost of the machine, in certain types of machinery; and sometimes even much higher than the direct labor cost of the operation itself. Any economy, therefore, which can be effected in tool costs is just as essential as savings in direct labor cost.

Truly the main spindle and its bearing mountings are the very heart of the machine and play an important role in prolonging the tool life of the cutting tools used thereon.

Let us take a look at Slide 1. Here



Slide No. 1

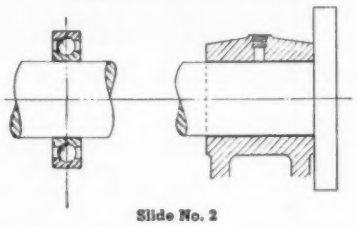
we have a conventional plain bearing spindle and bearing. In any plain bearing the minimum thickness of the oil film is very definite for conditions of load, speed, and oil viscosity. In order that lubrication may be maintained, this thickness of oil film must be larger than the combined height or depth of the minute imperfections on the surfaces of the spindle and the bearing. Otherwise rupture of the oil film will take place. A specific bearing pressure at which the oil film breaks down does not exist in the limits of practical application and the film is steady or uniform until rupture occurs due to its being mechanically pierced by the imperfections of the surfaces of the bearing or spindle. In other words, if the combined height of the imperfections of the spindle and the bearing were 20 micro-inches, the thickness of the oil film would have to exceed that height to prevent being pierced by these imperfections.

We hear a great deal about the right kind and place of oil grooves. It is a well known fact that oil cannot be induced to enter between working surfaces and function as desired unless a wedge shaped entry is provided. Sharp edges on oil grooves, no matter where they are positioned, prevent the functioning of the oil groove as a distribution medium and this has led to a change whereby grooves may be eliminated entirely. A distributing channel at a suitable point will distribute the oil in constant volume to the whole area under pressure.

In a properly designed bearing, the rotating spindle is at all times separated from the bearing by an oil film of appreciable thickness. No wear takes place. The only friction present is fluid friction, which is in no way destructive.

Kingsbury built an Air Lubricated Journal Bearing in 1890 and ran some wonderful experiments which proved a complete separation of surfaces and illustrated the general laws of film lubrication. Separation of the bearing surfaces was proved by failure of an electric current to flow across the film clearance space. The oil film bearing, therefore, by virtue of complete separation of all surfaces, is essentially durable.

Referring to Slide 2. Here is shown



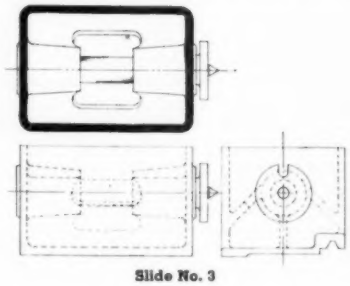
Slide No. 2

a typical plain bearing mounted spindle as compared with the ball bearing mounted spindle. This could just as well be a roller bearing, but is merely shown in this manner for the purpose of discussion. As previously stated, vibration and chatter are the worst enemies of tool life. One of the characteristics of chatter is its increasing amplitude of vibration as the chattering is prolonged. In other words, the amplitude of these vibrations increase similar to a fiddle string until they reach such proportion that either the machine or tool fails or is stopped entirely.

There are many causes of vibration, but the one most common is due to rotating a mass about some point other than its center of gravity. Let us call this mass whip. An ounce inch will produce vibrational force of 1.77 lbs. at 1,000 RPM, approximately 16.00 lbs. at 3,000 RPM, and 44.00 lbs. at 5,000 RPM.

The oil-film bearing does much to prevent this because as the chatter or vibration starts, it is cushioned out or dampened by the film of oil which prevails between the spindle and the bearing. However, with a metal-to-metal contact, such as is maintained with an anti-friction bearing, either ball or roller, no dampening or cushioning effect is there to break up the amplitude of these vibrations. Just compare the area of the bearing surfaces of the anti-friction bearing with that of the plain bearing and we can readily understand the difference between the two as to its cushioning and dampening possibilities as well as its load carrying capacity.

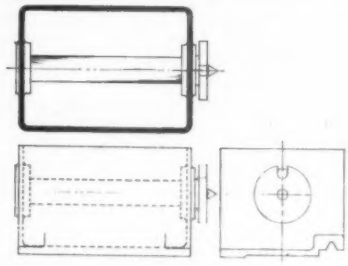
Let us for a moment refer to Slide 3, which shows the top and side views of an ordinary headstock spindle mount-



Slide No. 3

ing. Note the mass of metal which supports the spindle. Tool pressure would have no effect within the limitations of their cutting possibilities with this type of mounting. Rigidity and sturdiness will naturally prevail with a mass of metal surrounding this type of spindle, with a freedom of chatter and vibration.

Slide 4. Here we have the same headstock mounted with anti-friction bear-



Slide No. 4

ings. Just within the last year I have had experience with a machine which was constructed along these comparative principles which brought this to my attention. The designer of this machine, evidently, thought that the headstock construction, the metal surrounding it, was ample to take care of the spindle bearing mounting, but this proved to be a false conclusion because as the tool pressures were applied, a weave resulted from lack of rigidity due to the omission of ribbing and sufficient mass to support the tool pressures thrust upon it. Massiveness in appearance does not necessarily mean that the construction of the headstock will give us the rigidity required. I know of some instances where this type of construction is now being used and as long as the machine loads are light, the user will probably never have any difficulty, but as soon as heavy duty work is placed on this machine, chatter and the weave in the headstock will take place and the work will not be round when it is taken out of the machine.

Slide 5. This shows a piston which

Slide No. 5

was ground on a centerless grinding machine. The feed wheel was mounted on anti-friction bearings. Note the high spots or ridges created by the action of the feed wheel. Each high spot is created by the rollers in the bearings, in other words, there are as many high spots as there are rollers. Several hundred of these machines were manufactured and sold, but the quality of work produced was so unsatisfactory that the manufacturer of the machine was compelled to change to plain bearings. It is needless to add that this was an enormous expense, not only to the manufacturer, but to the users of the machines. Plain bearings were the answer to this problem, and the machines are now being built in that manner.

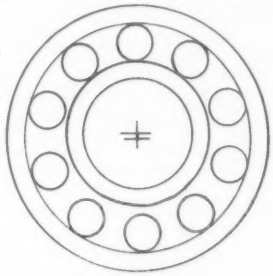
Whenever we hear of this, and similar failures of anti-friction bearings, the usual answer is that the wrong type of bearing was used or that it was not large enough or some other reason which has been charged to experience rather than to failure of the design. These excuses, or explanations, have been accepted gracefully and without very much questioning, but the time has arrived when we must take more stock of misapplications and failures and reason them out along more analytical and practical procedure in order that we can prevent similar failures in the future and to acknowledge our errors without any reservations. I am pleased to say that in the case of the centerless grinder, this was done.

Slide 6. This slide shows a double row of Fay lathes which were purchased in the fall of 1928 and have therefore been in use for over ten years —most of the time two shifts and occasionally three shifts. There has been less than $300.00 maintenance charges against these twelve machines, and where do you suppose the most of this $300.00 was spent. Why, it was spent on the ball bearing which supports the center in the tailstock ram. This is no unfriendly criticism of the bearing which was used to carry the center. Undoubtedly no other type of bearing would work any better, but in order to show where the maintenance charges were mostly spent, it is necessary to refer to this part of the machine.

The point that I wish to emphasize is that the spindle bearings on these machines have never been adjusted and are today in excellent condition. It is doubtful if they will ever be adjusted for the next five years at least. Truly, this is a wonderful example of machine tool efficiency with correctly designed spindle bearings.

It is interesting to look through the pages of catalogues on anti-friction bearings. I have selected two slides, taken from a well known manufacturer of anti-friction bearings. Therefore, what is shown is their claim, not mine. But I believe what they say is true, and in order to compare the relative characteristics between anti-friction and plain bearings, it is shown here.

Slide 7. Here we have a ball bearing, or it may be a roller bearing, which



Slide No. 7

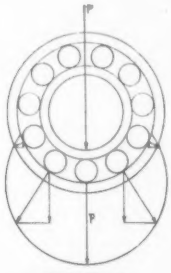
shows considerable wear between the inner race and the balls or rollers. Pure rolling is impossible to achieve. A definite small amount of sliding is always present and when wear occurs, we have an internal looseness or lack of contact which permits vibration of the spindle when tool pressures are applied. This wear could be forced upon the bearing on account of expansion of the spindle due to the heat generated by end working tools such as drilling or heavy turning.

If a preloaded bearing is correctly mounted, any radial expansion of the spindle would tend to expand the inner race of the spindle, which would therefore create an overloaded bearing rather than a preloaded one. The balls or rollers are subjected, under these conditions, to excessive wear on this account. Linear expansion would not affect the bearing to any great extent.

With a plain bearing the heat problem and expansion of the spindle is compensated for by a change in the viscosity of the oil, which allows for this expansion without disturbing the effectiveness of the spindle rotation.

It can readily be seen that the area of a plain bearing is much greater than any anti-friction bearing. When the load is applied to the spindle on a worn bearing, as shown in the previous slide, there is nothing to prevent chatter and vibration; whereas with a plain bearing this space is taken up by the oil film pressure, which will dampen and cushion out the vibration and chatter imposed upon the spindle.

Slide 8. This slide is also taken from the catalog. This particular slide shows



Slide No. 8

the load characteristics of the bearing. Only the balls or rollers in the lower half of the bearing will be under load, and the lowest ball will carry more than the others, while the two adjacent balls carry only a portion of the load. The next two balls show a very slight load carrying area. Thus when we look at a ball or roller bearing our first thought is that the entire load is distributed over all of the roller members; whereas the greatest proportion of the load is carried on one ball or roller only.

This maunfacturer further states that if there is one small weak spot in the races that comes repeatedly under load, it will fail. A minute fatigue crack will open and failure will spread rapidly because of the resulting interference in the path of the balls in rolling. With the projected area of a plain bearing, numerous fatigue cracks or weak spots could be prevalent and the spindle would continue to rotate and func-

Slide No. 6

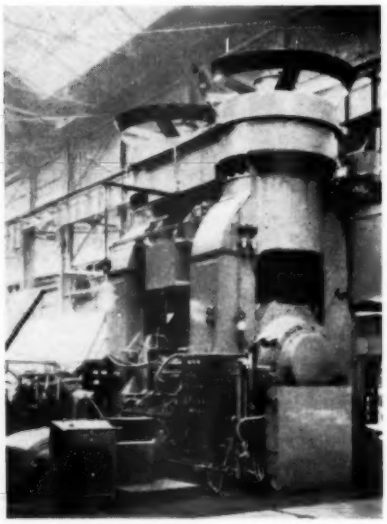
tion without complete failure. This is the end of the anti-friction bearing catalog notes.

I would like to add to this that any dirt of whatever nature, whether it be chips, dust, or oil contamination which would enter the path of the rollers or balls would likewise produce the same disastrous results.

We are told by the friends of anti-friction bearings that when replacement is necessary that the maintenance costs are greatly reduced by the ease by which these bearings can be replaced. In my own experience it has not been as easy as it sounds because of the tolerances permitted in the manufacturing of the bearings, the bore of the spindle housing does not always fit and it is therefore necessary to select bearings either on the high or low limit before the maintenance begins. The tolerances, except on precision bearings, are not close enough to permit replacement economically and satisfactorily.

Many of you have undoubtedly read the July issue of MACHINERY which described what the Norton Company of Worcester, Massachusetts, has done in the way of using kerosene lubricated wheel spindles as regular equipment on their types "B," "BA" and "C" grinding machines. The mirror finish of the spindle and bearing permits the use of kerosene as a lubricant, which has less film thickness than lubricating oil. It was stated that the bearing clearances could be reduced to approximately one-fifth of that formerly provided for spindle oil. It is indeed interesting to note that while being a radical departure from the conditions and methods of lubricating wheel spindles, it has many advantages for increasing accuracy and production over what has been used in the past.

I quote from the write-up in MACHINERY as follows: "As an experiment, the kerosene-lubricated spindle bearings were purposely set close to cause spindle seizure, but not the slightest injury to the spindle or bearing could be detected by close inspection. No re-scraping of the bearing or re-finishing of the spindle journals was necessary as a result of this test. . . . In another case, the spindle bearings were set so close that a considerable leverage was required to enable a man to turn the spindle by hand. When power was applied, it ran smoothly and satisfactorily." This clearly indicates that the complete separation between the spindle and the bearing by the oil film does take place.



Slide No. 9

The Tool Designer's Dream

By H. E. LINSLEY

DID you ever hear the story
Of the Tool Designer's dream,
When Klingenstein invented
His most wonderful machine?

There were cams and arms and levers,
There were epicyclic gears,
There was differential motion,
There were triggers, trips and sears.

There were alpha, beta, gamma rays
And fluorescent screens,
And the whole thing was for surgery
By ultra modern means.

For the purpose of this great machine
That's modern as today,
Was removing the appendix
In a high production way.

It was really very simple;
All the doctor had to do
Was to pull a certain handle
And to turn a switch or two—

And the automatic scalpels
Did the work in half a tick,
While the automatic needles
Sewed the wound up double quick.

But there's just one knotty problem,
And it makes Kling's brain revolve:
. . . The disposal of the body
Is the thing he has to solve.

It is interesting to note, too, that practically all types of cylindrical grinders as well as hobbing machines are plain bearing mounted. There is some objection to even mounting a ball-bearing motor on the headstock because, under load, the bearings surge and this surging creates vibration which is transferred to the headstock of the machine.

The automobile engine is a proven example of the development of plain bearings in that field of industry. The plain bearings of crankshafts, connecting rods and camshafts last practically the entire life of the car without any maintenance or adjustments of any kind. The automotive engineers have developed bearings which will render this kind of service without being influenced in any way except by final results. I cannot say the same about the machine tool bearings.

There seemingly has been an apparent trend towards anti-friction bearings without due consideration of the results which would follow. I believe that had the machine tool industry as a whole developed spindle bearings and lubrication in the same analytical way that the automotive engineers tackled their problem, we would not have this controversial subject to deal with today.

Some machine tool manufacturers, realizing that there is a growing tendency towards plain bearings, and which are most acceptable to them, have redesigned their machines so that either type of bearing can be used according to the wishes of the customer. This is indeed an ideal attitude on the part of the machine tool builder when he is willing to give the customer what he wants irrespective of whether his own opinions coincide, but must build what the customer demands regardless. The design of some machines does not lend itself to this combination very readily, but wherever it can be accomplished, the flexibility of such design makes it possible for the manufacturer to meet any conditions which might arise between the two types of bearings demanded.

We have been dealing with the lighter types of machine tools. Let us briefly go to a heavier type of plain bearing machine. Perhaps no more serious bearing problems can be found than in rolling mill practice. Time does not permit going into details of different types of bearings used, so I have selected the Morgoil type which ride on a film of oil. With Morgoil bearings the load is distributed over a large area —not concentrated in a few points. For this reason, failure due to compressive fatigue is impossible.

Accuracy has been proven time and again by the rolling of foil one-quarter of a thousandth of an inch in thickness at speeds up to 600 feet per minute and the rolling of hot strip steel 94" wide at speeds in excess of 2,000 feet per minute. These performances are common everyday practices made possible by the absence of metal-to-metal contact, and complete freedom from wear in the bearings. The only roll adjustment required is to compensate for the wear of the passes themselves—thus the accuracy of gauge is not confined to any one piece, but extends from piece to piece over a long run. This is certainly a remarkable demonstration of what good bearing design can accomplish together with the tremendous load carrying ability of a film of oil.

Slide 9. The world's largest and most powerful 4-High reversing cold mill equipped with Morgoil bearings.

Conclusion

In conclusion, I would like to emphasize that the right type of bearing, plain or anti-friction, in the right place, the elimination of vibration and chatter, and the utmost rigidity which can be obtained, is the desire of every Tool Engineer.

If the machine tool manufacturer, the user, and the bearing manufacturers would fairly approach this problem; each putting into it all that he has on the subject with an open mind, and with the hope that by the pooling of all the information available, something can be produced which will be of value to all. I feel sure, from an observation of the things that have been done in other fields, that if all the data were at the disposal of all concerned, plus the background of experience which could be put on the table by the users of machine tools, and put together in a friendly co-operative manner, the right bearing in the right place would be more closely achieved.

BEARINGS—Their Use and Mis-use

An abstract of a discussion by Mr. Herrmann on Bearings papers presented before this symposium.

By KARL L. HERRMANN*
ENGINEER, SOUTH BEND, INDIANA

MR. HERRMANN first discussed the improper nomenclature of bearings since the name Anti-Friction was descriptive of both types of bearings. The so-called Anti-Friction bearing is not entirely without friction and the properly designed so called plain bearing is frictionless in operation. The ball and roller type bearings can be descriptively called "rolling" bearings and the sleeve type bearing where the member slides on a film of oil can be descriptively called sliding bearings.

Many instances have been found where the application of "rolling" bearings have resulted in unsatisfactory operation of the machine on which they were applied and it is evident that the popularity of the "rolling" bearing has been developed as a result of carefully considered and well distributed propaganda. As an instance of such propaganda reference is made to the bouncing ball demonstrations resorted to by manufacturers of "rolling" bearings which so effectively attract attention to the product but which in no way advance or demonstrate the usability or effectiveness of a "rolling" bearing. Also the generous use of the word Anti-Friction, etc. effectively imprints the "rolling" bearing on the mind of the user at a time when the manufacturers of the so called "plain bearing" were at a loss to find even a suitable name for their product not to mention their total lack of attention towards propagandizing their product.

A further reason for the popularity of the "rolling" bearing may be due to the efficient method of distributing data on that product as compared to the lack of data on the plain bearing. Complete sheets of dimensions, capacities, tolerances and applications of "rolling" bearings were produced and distributed throughout all industry. These data sheets simplified the specification of "rolling" bearings and designers are prone to take the easiest way.

A fundamental fact is that neither type of bearing is satisfactory for application for important functioning unless machines are rigid and proper arrangement is made for self-aligning and expansion. Extreme examples of this are paper mill driers. The outer race, as has already been shown, on one end of the shaft must be arranged for sliding so that expansion and contraction can take place. Many of the manufacturers of the "rolling" type bearing have insisted that the outer race of the bearing must lie in the stationary attitude. This is an impossible application for we are all familiar with the fact that the outer sleeve will tend to stick in its operating position and you can't make it slide.

Both types of bearings must be accurate. Corner loading on rollers is just as certain to cause failures as corner loading on a plain bearing. Accuracy is necessary in the burnishing of plain bearings as well as in "rolling" bearings. This has been considered but very little by manufacturers of Machine Tools but manufacturers of plain bearings have worked out the processes of finishing the surface to reduce the height of projections and thus provide slight interference to maintaining a proper oil film which carries the load.

A further pertinent point as regards accuracy seems to be the fact that whenever an extremely accurate result is required, the plain bearing is selected to provide it. It is admitted that "rolling" bearings have variations of a quarter of a tenth, two tenths, half a thousandth etc. and it seems that the manufacturers of these bearings use plain bearings on the machines which produce this accuracy. In fact an error of .0002 of an inch would be too large on a bearing used in that large telescope in the West. Imagine an astronomer taking a sight on a star one hundred million light meters away and because of slight bearing error getting another star some hundreds of miles away. An error of .0002 of an inch is too great an error for many applications and plain bearings are used in those cases because of necessity.

Certainly the plain bearing has greater load carrying capacity, especially if made of proper materials, anywhere near similar to the materials used in rolling bearings, properly ground and reasonably burnished. This has been brought out in former papers where the point or line bearing was compared with the surface bearing. Finally, it would seem that the manufacturer of plain bearings has been slow in developing his product.

We find the plain bearing capable of carrying gerater load capacities, capable of greater resulting accuracies, and capable of longer life if properly made and installed. The prediction is that the "bearing of the future" will be a cartridge type plain bearing with inner and outer sleeves properly designed to provide and maintain the load carrying oil film and properly sealed against dirt.

* Karl L. Herrmann is the developer of the new type aircraft and automobile engine known as the Herrmann Engine.

DISCUSSION on BEARINGS

By S. L. CRAWSHAW
APPLICATION ENGINEER, NUTTALL WORKS, WESTINGHOUSE ELECTRIC & MFG. CO., PITTSBURGH, PA.

THE papers which have been so ably presented on this controversial subject today should keep us all "bearing minded" for some time to come.

Rather than with the thought of being able to add materially to the discussion already given, I find my remarks directed to the comparison between the two types of bearings, hoping to emphasize some of the points which impressed me.

The machine tool industry has and is going through a major development period in which the designer is facing the problems of higher standards of accuracy with ever increasing loads and speeds. The purchaser of any machine tool today is expecting (and getting, thanks to you men) better performance, longer life, reduced maintenance and more quiet operation from each new model, than that obtained from yesterday's peak of perfection.

Whether or not the heart of the machine is its bearing arrangement, we can all agree that it performs a very important role in the machine's performance. It is, therefore, interesting to analyze the various factors which govern or influence the type of bearing used. With the wide variety and style of ball and roller bearings and the varied design proportions of sleeve bearings available, it is necessary to study each application if the most economical selection consistent with desired results is to be achieved.

Since any bearing must be an anti-friction device whose purpose it is to maintain proper relative positions of the stationary and rotating parts and increase ease of movement at the point of contact, we may well ask why the term "anti-friction" has come to designate ball and roller types in preference to sleeve bearings. A logical reason may be due to their ability to maintain an almost uniformly low coefficient of friction during wide variations in speeds and loading, whereas, the plain or sleeve type will exhibit widely varying values under wide variations of speeds and loading.

Previous speakers have brought out

the fact that the so-called anti-friction type of bearings develop metal to metal contact under load, whereas the sleeve bearing depends entirely on its ability to build up and sustain an oil film. There are peculiar advantages for each type due to this fundamental difference. The sleeve bearing operates with less noise due to the absence of metal to metal contact and the cushioning effect of the oil film. The anti-friction type maintains a more accurate shaft positioning due to low clearances. The sleeve bearing is more capable of absorbing shock loads due to the lower unit pressures and the absorption qualities of the oil film.

Plain bearings are eminently successful in many cases and when all the conditions surrounding their use and operation are known to the designer, they can be made to produce the ultimate in satisfactory results. All of us have been fascinated with the action of a plain journal in lifting itself up and being carried on a film of oil. This pressure, developed to suspend or float the shaft free of the journal, is nevertheless only acting while we have rotation. Continuous pressure (and rotation) is necessary to keep the shaft and journal apart, and pressure varies with the speed. With the cessation of rotation, however, the weight of the parts may be sufficiently great to squeeze out the film and permit the metals to come into contact. Also the variation in lift and drop with the load and speed may result in comparatively great and small film thicknesses within the limits of the design clearance. Does not this, then, give us a clue to at least a partial solution of vibration and chatter? One of the main objectives in designing any machine tool is to eliminate vibration and chatter. Is not this varying film thickness, which faces the designer and user of a plain bearing on extremely accurate work—such as machine tools perform—a major consideration in producing a smooth, non-chattering and non-vibrating assembly? A spindle may run at various speeds and different loads may be imposed so that one machine may work in one case and not in another. To make the latter work it may mean a change in clearance or oil viscosity, or both, since speed and load affect film thickness and consequent movement.

Furthermore, during normal cycle of operation and stopping of the machine, we have the film built up and then destroyed. Then the shaft is rotated after a shutdown, it is in contact with the journal, and if the load is heavy some slight abrasion may take place before the hydraulic pressure is built up to separate the two parts. If this is repeated a great many times, it is reasonable to believe that the cumulative abrasion is such that the film is developed with increasing difficulty due to the destruction of the original form of the bearing and escape of the oil laterally along the bearing surfaces. During the life of the journal this abrasion progresses around the surface of the journal until some area has been affected. This may be of such small extent that it is hardly discernible to the eye or it may mean a very badly damaged sleeve, but in either case the resulting damage may cause unsatisfactory work due to the vibration and chatter set up by the increased play in the bearings.

Accuracy is the by-word in modern machine tool business relations. This is the one requirement which has fostered the development of precision anti-friction bearings. Present day machine tool accuracy would appear impractical with sleeve bearings since their required running clearance is often many times greater than the permissible error in shaft position. Furthermore, since the thickness of the oil film varies with load and speed, the location of the shaft center would not be fixed. The precision anti-friction bearing with such special features as individually selected balls to as close a tolerance as ⅛ of ⅒ of ⅒₀₀₀ and light weight balanced cages practically assure its user of positive center location without much fear of change due to load and speed fluctuations.

Preloading has been introduced to eliminate the initial clearance in bearings, either ball or roller, and when this practice is used, the radial clearance or freedom is reduced or eliminated, not only at the point in the bearing which is carrying the heaviest load, but also throughout the full circumference of the bearing. By suitable studies of the particular bearings used in a given case, proper preloads can be assigned so that no difficulties are experienced from heat and expansion.

Reference has been made to the marking of product caused by the metal to metal contact between balls or rollers as they passed through the load zone. It would be interesting to learn if this was one of today's precision bearings. High spots on centerless ground work have been known for considerable time and were first experienced and investigated when centerless grinders were made with no ball bearings whatsoever in their construction. When anti-friction bearings were first applied to many machine tools the art of preloading, as now widely practiced, had not come into widespread use, and very possibly the trouble referred to could have been corrected using present-day knowledge.

The smoothness of operation of today's commercial bearing is many times better than yesterday's precision bearing and by the same token, today's precision bearing made of specially selected parts and run through noise and speed test is proving successful in grinding spindles.

Rigidity of the machine or bearing housing need not be lessened with anti-friction types as one speaker suggests. As a matter of fact, the less amount of axial space occupied by ball and roller bearings usually permits a reduction in overhung load moment arms, so that with the same centers as with plain bearings, the actual stiffness of the shaft would be improved. Proper mounting is necessary in any bearing if it is to be expected to carry its rated load without distress.

Vibration and chatter both imply some movement or deflection of the parts. Any load on a shaft produces some deflection (and this deflection will exist regardless of how this shaft is supported.)

Vibration due to deflection of the parts is one problem and movement permitted by the varying thickness of the oil film is another. No type of bearing will eliminate the spring of a shaft entirely. Wider bearings will, of course, change the characteristics.

Often it is deflection in shafting that induces bearing failure and it may be worth while repeating here that size alone determines the deflection rate of shafting—alloying or heat treatment does not materially improve the modulus of elasticity.

Lubrication is an important phase of any bearing problem. Even if the ball or roller bearing does not need oil or grease for the primary purpose of carrying the load, there is sufficient slippage of parts and rubbing between cages and balls or rollers so that a good grade lubricant is required to prevent serious failures. The improvement in lubricants and lubrication methods in the past ten years is evidence of the attention this problem has been given. Part of the job in supplying clean oil or grease to the bearing is the manner in which contamination from dirt, abrasive dust and chemicals is prevented. Here again the anti-friction bearing has an advantage in that the reduced radial clearances make it easier to provide a tight housing.

Dirt is the greatest enemy of plain as well as anti-friction bearings, and when it is introduced through the lubricant applied, it can do considerable damage to both kinds of bearings.

The sleeve bearing has the edge on anti-friction types in locations involving repeated shock loads due to the greater area in contact with the shaft and the cushioning effect of the film. Applications involving intermittent motion, that is, where the bearing housing rotates with the shaft during a portion of the load cycle, are also better suited to the use of sleeve bearings. Anti-friction types show definite tendency to "brinell" the races under such conditions.

Large machine tools are following the trend to anti-friction bearings although sleeve bearings are still widely used in this field due to the simplicity of replacement or reconditioning. Many of these equipments utilize flanged shafts to advantage and the split type sleeve bearing is a valuable ally in these designs. Split type anti-friction bearings are being experimented with, but localized high contact pressures are a serious barrier for their successful operation.

Interchangeable types of ball and roller bearings, with respect to shaft

(Continued on page 42)

QUESTIONS and ANSWERS on BEARINGS

A FURTHER DISCUSSION ON THE SUBJECT

DR. M. KRONENBERG (The Cincinnati Milling Machine Company, Cincinnati, Ohio): I would like to know the temperature rise which is considered to be satisfactory for 1500 R.P.M. 2-hour run for anti-friction bearings of 4 inches in diameter and for 450 R.P.M. for a 7-hour run. That is the first question. That goes to Mr. Ewart.*

MR. EWART: Well, to know that, we would have to know something about the nature of the load. Of course, it would depend on your lubricant. I gather what you would like to know is the maximum temperature rise which you could have on an anti-friction bearing without hurting it. Principally, is that the question?

DR. KRONENBERG: Without too much expansion of the bearing.

MR. EWART: How large a bearing?

DR. KRONENBERG: Four inches in diameter.

MR. EWART: You could have considerable temperature rise in a bearing of that size without getting into trouble, I believe, if it were a free wheel bearing.

DR. KRONENBERG: An idle bearing.

MR. EWART: The clearance?

DR. KRONENBERG: I would say a free load of 1000 pounds.

MR. EWART: Without stopping to figure it out, I believe that you could run such a bearing up to approximately 150 degrees without tightening up sufficiently to seriously affect your free load, or in other words overloading the bearing.

DR. KRONENBERG: Thank you.

I would like to know whether some tests have been run so I can get some further information.

MR. EWART: Yes, if you will give me your name and address, I will be glad to see that you get them.

DR. KRONENBERG: May I ask a second question, also of Mr. Ewart?

What is considered to be the smallest amount of oil for the lubrication at 1500 R.P.M. for (a) tapered bearings, (b) angular bearings, and (c) ball bearings? Is it considered to be better to use a larger amount of oil or a small amount of oil?

MR. EWART: That depends again on certain other factors that you would have to know. There are about two cases with extremely high speed operation that I mentioned in my paper briefly. Take the two roll tapered bearings on one end of a spindle and a straight lip guided roller bearing on the other end, and running up to 5500 feet per minute pitch line speed, in that case a compromise was necessary, as is usual in the lubricants. In other words, we would have preferred an extreme pressure fluid lubricant. While a straight mineral oil is perfectly satisfactory for the lip guided straight bearing, but due to the extreme speed at that time, which was several years ago, none of the manufacturers of steam pressure lubricants could assure us that at extremely high adjoining speed that their lubricant would not separate, so that we used mineral oil, and we found that the amount of oil we could run through the bearing itself without excessive heating was limited, but we also found that auxiliary space on the sides of the bearing, carrying quite a large volume of oil. Fortunately, we had a pump which was bigger than necessary for the job and was of quite decided advantage in assisting in cooling the bearing.

DR. KRONENBERG: Is it a spray?

MR. EWART: Several sprays on the sides of the bearing.

Now, in regard to the size of the oil body—that is, the amount in the reservoir—we changed that completely in building these machines. We have quite a small oil tank, and we insisted on their providing a ten-gallon storage tank, because of the cooling effect of the larger body of oil.

Does that come close to answering that question?

DR. KRONENBERG: Thank you.

MR. EWART: If you will let me have those questions, I will be glad to communicate with you.

DR. KRONENBERG: I have one question of Mr. Bouton. How does the thickness of the oil film in plain bearings affect the temperature rise? Don't you work very much on the oil, so generating heat, when you have a thin oil film?

MR. BOUTON: If this bearing is of adequate size and has the capacity to sustain the load, the oil that you use for oiling your machinery may be S.A.E. 20 or S.A.E. 30, or whatever viscosity you choose to use. Those bearing clearances then are sufficient to run that spindle so that it doesn't heat. But if heat is created by the hand-working tool, which you can't avoid, then as your temperature rise goes up your viscosity changes, because that is the way viscosity is measured on a temperature basis. That is where, if this expansion takes place, the oil thins out and doesn't disturb the clearance sufficiently to create any rubbing action or metal-to-metal contact through the spindle. It is flexible in that respect, whereas an anti-friction bearing, in my opinion, isn't that flexible.

MR. W. M. HELM (Timken Roller Bearing Company): There are a couple of points I wanted to answer in the doctor's question.

We have found on high-speed bearings that the quantity of oil sometimes doesn't affect the heat condition. In other words, it is possible to obtain churning of the oil, and due to the tapered construction of the bearing sometimes you do obtain a centrifugal action which tends to work the oil from the small end of the roll to the large end of the roll, and for that reason the taper on the outer race quite frequently determines the temperature in the bearing. In other words, if the outer race has a steeper angle, the oil will tend to work to the bearing faster.

We have also found that the length of the roll sometimes determines the heating in the bearing.

MR. ARTHUR B. BOK (Chief Engineer, Kent-Owens Machine Company, Toledo, Ohio): The question I am about to ask might be none of our business, but as a Tool Engineer I am inquisitive about how they manufacture the Torrington bearing—that is, the method of heat-treating it and curling in the last edge.

CHAIRMAN HAWKEY: I presume you have the needle bearing in mind. I don't know if any of our speakers are qualified to speak on that. Mr. Ewart, would you care to?

MR. EWART: The Bantam Bearing Corporation is a subsidiary of the Torrington Company. While we are not directly connected with the manufacture of the Torrington bearing, I can answer a part of your question at least.

The rollers in the Torrington bearing are S.A.E. 52, 100. The shells are case-hardened.

MR. BOK: You mean plate-hardened.

MR. EWART: No, they are sanded. One end of the shell is turned over in the initial drawing operation. Those shells, by the way, are deep-drawn in the cartridge press from strip steel. One end then is on there by the time we put the rollers in. The other end is then cupped over after putting the rollers in, but the end in there, inside that lip, is hardened also.

I don't know whether that answers your question. It is about as much information as I can give you.

MR. BOK: How is that end inside the lip hardened after assembly?

MR. EWART: It is hardened before assembly.

MR. BOK: You don't rupture your case in that way?

MR. EWART: No. I understand there was some trouble along that line early in the game in making that bearing, but I haven't seen any trouble of that kind for a number of years.

MR. BOK: What do you think of cyanide for the bearing race?

MR. EWART: For an extremely heavy-duty bearing, we don't do it. That Torrington bearing is a lighter duty bearing. It is sufficiently good for a lot of things. As you know, it sells at an extremely low price. A great many people, when it was first brought out, did not think much of it. Frankly, my own opinion of it wasn't so good at that time, but last month alone the Torrington Company shipped in the neighbor-

(Continued on page 28)

* Editor's Note: Mr. H. E. Ewart had read Mr. S. R. Thomas' paper, owing to inability of Mr. Thomas to be present at this session.

JOHN A. MACDONALD

In this day and age, tool designing has become very much of a custom-cut affair. What would be good tooling for one job, would not be correct or profitable for another. Much depends on what function the product performs or to what extent quantity production can be attained.

By John A. Macdonald

CHIEF TOOL DESIGNER
CATERPILLAR TRACTOR COMPANY

An address given before the regular monthly technical session of the Chicago Chapter, American Society of Tool Engineers, at the Midwest Athletic Club, Monday, October 2nd, 1939. This meeting was attended by more than four hundred Tool Engineers of the Chicago Industrial area.

Behind the Scenes in Tool Design

TO THE experienced Tool Engineer it makes little or no difference whether a company produces tractors or peanut vending machines. In his tooling analysis, production requirements, available production machines and quality standards are the factors he considers.

Therefore, tonight having viewed the many interesting exhibits of various cutaway units which comprise a "Caterpillar" track-type tractor, one is at once impressed by the size and weight of the units, as compared with the general popular idea of such things—also the intricate mechanisms, the craftsmanship, and precision construction.

But having viewed the film of the actual tractor at work and witnessed the grueling tasks these tractors are called upon to perform, one can readily understand that no ordinary manufacturing methods would meet the exacting requirements this outstanding product demands.

In glancing through the recorded accomplishments accredited to engineering skill and effort in every field of endeavor, little reaches the headlines of the tireless planning and scheming that goes on behind the scenes in the tool division of every manufacturing concern where ways and means are devised to produce the shining examples of modern engineering skill, or the lack of ceremony with which the product engineering group places its "brain child" on the tool division's lap, and say as it were "the world is waiting for it, it's your baby now, go ahead, make it."

This lack of recognition, in spite of the A.S.T.E.'s many years of concerted effort still exists. In fact, it is also coupled with a distinct lack of knowledge on the part of the general public to the fact that we exist as a distinct semi-professional or occupational group at all.

Why just recently, a doctor of medicine inquired as to what my business was and upon learning I was a tool designer, expressed surprise "Why," said he, "I didn't know 'Caterpillar' was in that line of business let alone employing men to design them." "Why," he said, "I haven't seen any difference in them since I was a kid. In fact, I am still using the same hoe and rake my grandfather used around the old homestead."

Well, perhaps, some of us "as Tool Engineers" would make better gardeners. In fact, I recollect somewhere hearing a song about an old guy "Macdonald" who had a farm.

Inquiring further into this lack of importance attributed to our work, I turned to the old reliable "Webster's," the 1937 second edition unabridged — a very large voluminous book. Under "tool" I found 62 combination words of phrases—tool bit, tool grinder, tool maker, etc., but not a "tool designer" or even a Tool Engineer.

The truth is we are a minority group and as such, having failed so far to assert ourselves and establish our place in the industrial sun, we must therefore take the minority back-seat, and like the tail wagging the dog, continue to drive on to new and greater accomplishment from that spot—confident in the knowledge that any advancement forward in the march of progress, producing things better and differently will only be as fast as we Tool Engineers can devise ways and means to do the job more profitably.

Actually, as a group, we represent about one per cent of the vast engineering and manufacturing group we serve. But even at that we have not yet reached the actual tool designer. Within that one per cent group my experience finds that only about one in every six now working at the business could qualify as a competent tool designer—the other five being merely tool draftsmen of varying degrees, thereby indicating that the opportunities for outstanding mechanics who can acquire the airs of an engineer, and express intelligently in the language of the drawing board, the crying needs of the production shops and assist the product engineers in making their dreams come true, are as good today if not better than at any time in the history of the business.

In view of the fact that on every side of us we hear the continued cry about the shortage of skilled help, I would like to dwell for a moment on the man whom I have often referred to as the "pencil pushing mechanic, who is neither fish nor fowl," because it is true the engineers will not accept him and once he establishes himself as a tool designer, he is ostracized by the shop men. So let's therefore, look at his expected qualifications, training and experience.

First, he should have acquired several years of shop practice and be experienced and have an intimate knowledge of tool making methods and pro-

cedure. He must have acquired "factory feel" or consciousness of the plant atmosphere and surroundings to visualize the conditions the machines or tools under consideration have to be used in.

This faculty is very important and often is the difference between the design of a first class tool that goes right to work and one that is of a very questionable character.

In other words, it's that finished touch that distinguishes an artist from just another painter. Also in this respect his years of shop experience produce a good working knowledge of all the standard and semi-standard machine tools and familiarity with all the possibilities and limitations these machines possess. It is in this particular respect that actual shop experience is beneficial because it removes guess work and doubt from an element in tool designing that is not exactly subject to calculation, and without which is responsible for much delay or stalling of the job on the drawing board.

Another essential requisite is familiarity with pattern making and foundry practice, and when applied to his designing, helps to eliminate many awkward pattern making and casting problems and incidentally, helps materially in holding down costs of the tool to a minimum. I have seen many good ideas scrapped or passed up because of impractical or expensive design in this connection.

Second, as to his theoretical make-up, this can be acquired in several ways, either at any accredited mechanical school or college or by home study, concurrent with his work in the factory or designing room. However, it should consist of at least two or three years study in engineering and appropriate mathematics and, to be up to the minute, at least more than a nodding acquaintance with metallurgy, all of which is desirable and necessary to produce a good base or foundation for the theorizing and analytical studies which proceed the design and which of course must govern the application of correct principles throughout.

This combination also produces good analytical powers to study conditions and possibilities, and more important still, is the ability to come to good sound conclusions.

You no doubt have noticed this particular trait in men in all walks of life who are "tops" and distinguishes them in their ability to sum up conditions and circumstances and arrive at the answer with reasonable assurance of success—it's the conclusion, that motivates the action he takes, that counts.

The up-to-the-minute tool designer must also be continually on speaking terms with what is going on and what has been done in the tooling art within the industry. This thorough practical knowledge and experience eliminates unnecessary delay through costly experimentation or redesigning.

Strange as it may seem, when we view the progress of the last decade or more, we find that basically very little that is genuinely new has been introduced. Age old principles are still in effect but are continually being dressed up and given new applications —that in part seems to be our responsibility.

However, in effect this combination of practical and technical training should produce a mental make-up which gives a leaning toward the practical side in a proportion of about 60% practical and 40% theoretical.

It is also necessary to stay in this field and not be an in and outer, if top standing is going to be maintained. Because the field is very broad and continually changing in methods and practices if not in principle, that one very quickly becomes out-moded.

Those firms who have in past years developed a system of apprentice training are in the most favorable position to man this vital phase of modern mass production, we at "Caterpillar" are fortunate in this respect, having at our call a young man group with the ground work well laid to meet the foregoing qualifications, these young men having acquired some four years actual machine shop experience, coupled with advanced studies in applied mechanics and mathematics and at present, out of a total personnel of 100, some 35 are recruited from this graduate apprentice group.

Well, so much for the man and his qualifications at present. Now let's look at the cause for his existence, and picture as it were the field in which he works.

Now for the purpose of control, the field is divided into the sixteen major production methods, procedures or processes which go to make up a well rounded, up to the minute, manufacturing plant, grouped substantially the same in sequence as they are at present under my supervision.

Group A. Press tools, treating every phase of light and heavy sheet metal and structural steel working which goes into the fabricating of parts, such as blanking, piercing, forming, drawing and shaving dies and punch press equipment.

With the advent and rapid extension of welding practice this group inherited the specialized line of tools, jigs and fixtures necessary for satisfactory attainment of sustained duplication and interchangeability of parts made by this valuable method of modern construction.

Group B. The popular type of production jigs and fixtures sub-divided as follows:

1. Milling in plain, duplex, drum and rotary applications, with single and multiple set-ups.

2. Boring in all its variety of possibilities.

3. Drilling, reaming and tapping, possibly the broadest field of endeavor and a fertile field for ingenuity.

Group C. Treats some of the finer lines of tools arranged as follows:

1. Gear cutting, hobbing, Fellows shaper and Gleason bevel gear generat-

(Continued on page 42)

"ELEMENTS IN TOOL DESIGNING"

1—PIECE PART
(a) Study piece part drawing.
(b) Establish mental picture.
(c) Relate same to operation being considered.
(d) Determine if in rough state or process.
(e) Check operation sequence.

2—THE MACHINE
(a) Check type and capacity of machine assigned to the operation to be performed.
(b) Check possibilities and limitations.

3—PRODUCTION REQUIREMENTS
(a) Determine the type of jig, fixture or tool best suited to meet requirements.
(b) Will available machine burden require manual, semi or full automatic —single or multiple set-up?

4—METHOD OF LOCATION
(a) If first machining operation on castings or forgings, determine if location points have been provided to insure equal distribution of metal on all subsequent operations. If not, plan location accordingly.
(b) Determine points of relationship and maintain continuity throughout machining process.
(c) Study possible arrangement of location points on fixture to facilitate cleaning.
(d) Is fool proofing required?

5—HANDLING
(a) If by hand, be sure part is within handling capacities.
(b) If by hoist, check facilities and necessary sling clearance and provide loading skids when necessary to insure easy handling when sling is removed.
(c) If by conveyor, check to maintain correct height.

6—LOADING AND UNLOADING
(a) Provide ample hand clearance to insure ease of manipulation.
(b) Can reasonable balance be maintained to insure safety?

7—CLAMPING
(a) Are loads static or shock?
(b) Determine type of locking medium most suitable.
(c) Arrange to maintain maximum rigidity without distortion.
(d) Will action mar or injure part?

8—POINTS OF THRUST AND TORQUE
(a) Can satisfactory blocking be arranged to withstand cutter feed strains, distortion, and shift?
(b) Avoid clamps carrying thrust loads.

9—CHIPS
(a) Provide ample chip clearance and convenient means of removal.
(b) Avoid blind spots and traps.

10—CAPACITIES
Will proposed design come within the column clearance capacity, table and spindle travel of assigned machine?

11—IS JOB DRY OR WET?
Is machine equipped for coolant? Can suitable coolant reservoirs be provided?

12—PERISHABLE TOOL
(a) Can design be arranged to insure use of standard catalog tools? (drills, reamers, milling cutters, etc.)
(b) Can use of existing special tools be incorporated?
(c) Have provisions been made to secure all "specials"?

13—STANDARD PARTS
Does proposed design incorporate fully the use of all standard jig and fixture parts carried in tool room stock?

14—LOOSE PIECES
How can proper identification and storage be provided for all loose clamps, removable locating plugs and adaptors?

15—BALANCE
Have balance weights been figured and provided for on all Trunnion and indexing fixtures to insure safe operation?

16—PROGRESSIVE EXPERIENCE
(a) Does similar type of equipment exist? If so, what has been our experience?
(b) Have machine shop or tool room suggestions been acted upon and incorporated?

17—CAN IT BE BUILT?
(a) Does proposed design include any "impossible machining problems"?
(b) Does it conform to all known tool room machine capacities?

(Continued on page 48)

IT'S NEW

The Tool Engineer (buyer) looks at new equipment. A practical manufacturing executive has gone over the entire field to bring you on this page each month, those items he feels are of importance and interest to the Tool Engineer at a time when production is at a high peak, and equipment buying is reaching an all-time high.

Taft-Peirce is out with new developments, besides making available to industry several tools originally designed for use in the Company's own plant, where they have been tested over a period of time. A new T-P Surface Grinder is compact, yet of heavier, sturdier proportions than usual, employs ball bearings for all rotating shafts, with ball tracks of hardened alloy steel to control table, saddle and spindle column travel. This construction permits the uniform parallel and rectilinear motions so essential to accurate surface grinding, also eliminates inaccuracies due to variations in temperature, oil film or wear of table and saddle ways.

Ball bearings minimize friction, resulting in freer table travel, and entail less effort in the hand feeding commonly employed on high-precision small work. Spindle column is exceptionally heavy, while a unique mounting of wheel spindle permits it to swivel in a vertical plane, which simplifies set-up and adjustment.

In line with improvements in grinding, Taft-Peirce also announces the T-P Superpower Magnetic Chuck developed primarily for use with No. 1 Precision Grinder but which can be used as well on all types of surface grinders adequate for its size. A fine mesh face plate permits holding extremely small work directly on chuck surface without resort to adaptors, while unique magnetic characteristics make it possible to employ solid steel parallels, angle blocks etc. for making special set-ups. Available in 110 and 220 volts, D.C.

Long used as special chucking accessories by toolmakers and grinding machine operators, a line of Magnetic Parallels and Vee Blocks is now available commercially at costs far below that of improvising "specials," Taft-Peirce having placed a complete line on the market.

Rounding out new T-P grinding equipment is a Demagnetizer for Superpower Chucks, of larger capacity than the original alternating type. A double unit is now available with the same operating characteristics as the single unit type. It can be plugged into any light socket, when it functions quietly and efficiently and economically, without moving parts. It can be furnished connected for either 110 or 220 volts, 60 cycles single phase A.C., has rating of 130 watts. Taft-Peirce, Woonsocket, R. I., will give full information regarding this equipment on request. Mention The Tool Engineer.

▼ ▼ ▼

Van Norman Machine Tool Co., Springfield, Mass., two new Ram Type Universal Milling Machines, No. 26 and No. 36. These machines are new from base to overarm, are thoroughly modernized and designed for convenience of control and adjustment, and accuracy. The ram is of new design and construction, is larger and heavier, has an entirely new gear transmission with heavier gears mounted on spline shafts rotating on ball bearings. A new and convenient speed change provides 18 changes in geometric progression from 30 to 1500 RPM. Changes are simply and quickly effected with two levers on front of ram, "high" and "low" ranges obtained with a push-pull knob.

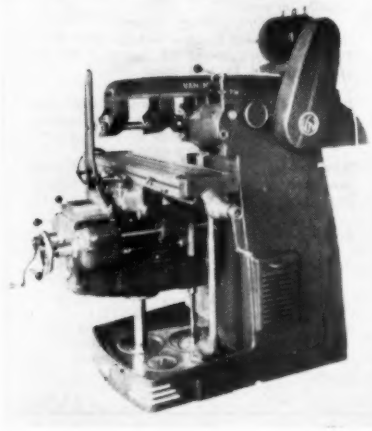
Cutter head is materially larger and more rugged than in previous machines, is of streamlined, bullet type construction with greater bearing surface on ram. Rigidity is assured by an improved method of locking head to ram through four bolts; combined with hardened and ground spiral bevel drive gears, remarkably heavy cuts, size of machine considered, are possible.

Cutter spindle is of large diameter, is hardened and ground and has double opposed Timken bearings on front end. Back end provided with ball bearings arranged to compensate for expansion. Nose is fitted with No. 50 Nat'l. Standard taper (3½" per ft.) and face of cutter head is machined to take attachment. A ram type overarm 43" long, with double taper bearing on ram overarm ways, provides rigid outboard support for cutters and attachments.

The design discloses a "streamlined" column, with long way length for securely holding ram unit; the gibbing and locking devices also appear to provide solidity beyond actual need. In harmony with modern design, feed motor is enclosed in column, with fin type louvers at front and side providing ample ventilation and accessibility to motor as feed drive units. The base contains eight gallon coolant tank, with provision at back of machine for independent motor operated pump. A

The new Taft-Peirce Surface Grinder is heavier and of sturdier construction, employs ball bearings for all rotating shafts . . .

Van Norman has produced a milling machine —"new from base to over-arm . . . thoroughly modernized . . . has an entirely new gear transmission . . . a new and convenient speed change . . ."



Norton's new developments are the Hydrolap and the Cam-o-lap (Cam-o-lap shown below). The Cam-o-lap is designed for the automatic lapping of camshafts—all cams and bearings simultaneously.

screened drain on base returns overflow to tank. Cutter head motor is mounted on column, where it is out of the way yet readily accessible.

With its rugged knee, massively constructed to support table and saddle units, forethought to convenience and ease of operation, this new Van Norman should meet ready acceptance. We suggest that our Tool Engineers and machine tool users get acquainted with its possibilities.

▼ ▼ ▼

Norton Company, Worcester, Mass., is out with new developments as well as redesign on previous lines, effecting improvements in tested and proven equipment. A new Hydrolap machine, known as the No. 26, uses two bonded abrasive laps and is stated to be an extremely fast cutting machine, the number of parts finished in one load depending on their size. Refrigerator and automotive parts—as piston rings —and any flat part within range of machine can be finished flat and parallel within extremely close, predetermined limits.

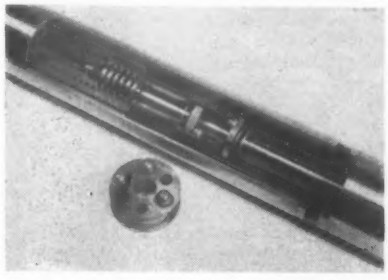
The machine can be adapted for either flat or cylindrical work. A lever regulates lapping pressure, adjustable from 20 to 100 lbs. per sq. inch, while a hydraulically controlled swinging arm, carrying two diamonds, trues the upper and lower lap faces simultaneously.

Also in the lapping line is the Norton No. 30 Semi-Automatic Cam-O-Lap, designed for the automatic lapping of camshafts. This machine laps all cams and bearings on any automotive—or similar —camshaft simultaneously and automatically. The operator only places the work in the machine and moves a lever. From then on everything is automatic; the operator does not even have to release work from centers or stop the cycle; all that is necessary is to place a new shaft in the machine. Two hundred twenty-five camshafts per hour has been established by Norton, by one operator on two machines.

▼ ▼ ▼

To readers who are not familiar with oil well pumps, the sectional view of a 3" Kobe hydraulic (rodless) pump may be of interest. A neat piece of designing, eh? The original, shown at the Carboloy Exhibit at the National Metal Exposition, Chicago, is illustrative of the diversified use of Carboloy as a wear resistant. In this case, it is used in the form of balls and inserts, shown better in the disassembled unit in front of the pump. Carboloy cemented carbide is said to have made this pump commercially possible; prior to its adoption, this type of pump was impractical due to rapid abrasive wear on valves made of ordinary metals. A case of new things remaining new because engineers find recurrently new uses for them.

Illustrated below is a section of a 3" Kobe Hydraulic (rodless) oil well pump, equipped with Carboloy Valve Ball and Valve Seat inserts. These Carboloy parts resist the abrasion of crude oil containing sand and water. A disassembled unit, showing the Carboloy parts, lies in front of the pump.



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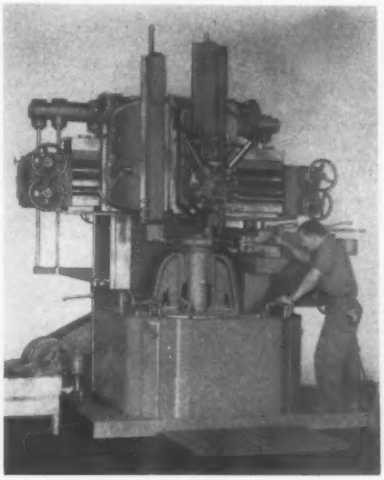
The Bullard Company is out with a new line of Bullard Cut Master Vertical Turret Lathes, ranging through five sizes: 30", 36", 42", 54" and 64". These machines are designed to meet all demands of modern carbide and other high speed cutting tools; according to the makers, one set of single Tungsten-Carbide tools removed 220 cubic inches of cast iron per minute. From a designer's viewpoint, this seems reasonable enough, considering the rugged construction of the line.

With exception of 30 and 36 inch machines, designed for two heads—a main turret and a side head—the line is designed to carry three heads; left hand Main Ram head, a right hand Main Turret Head, and the side head. However, buyers are given choice of heads to meet individual requirements. An interesting feature is that all heads and functions of the machine are protected by interlocking and limit switches, to guard against possible damage to machine by forgetfulness or careless handling. Either rail head may be swiveled 30° either side of vertical center for machining angular surfaces, and the heads can also be fed horizontally and their respective rams fed vertically at the same time for machining any angles up to 45°. There are various other features, all of them improvements on an old and dependable line of cost saving machine tools. The Bullard Company, Bridgeport, Conn., will furnish full data and description on request.

Bullard Company is out with a new line of Cut Master Verticle Turret Lathes, in five sizes, and designed to meet all demands of modern carbide and other high speed cutting tools. There are various new features and improvements.



New Release Spring, improving Universal collet chucks, follows close on the heels of two improvements in their collet chucks announced in June, the Universal Engineering Company, Frankenmuth, Mich., last week announced another new feature which, it is claimed, greatly improves their product. It is an automatic release spring which works as follows: As the nut is turned, a spring (behind the collet) forces the collet forward allowing it to spring open, thus automatically releasing the grip on the tool. Universal Collet Chucks now have threads ground from the solid after hardening assuring concentricity, a handy wrench grip, an automatic release spring, and a complete range of sizes from $\frac{1}{16}$" to 1½" ready for immediate delivery.

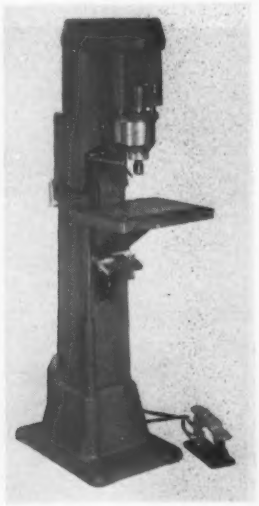
▼ ▼ ▼

Neat and handy tersely describes the No. 2-C Air Controlled Tapping Machine, product of R. G. Haskins Co., 2756 W. Flourney St., Chicago. It has a capacity of from No. 8 to $\frac{5}{16}$" in steel and ⅜" in brass. In the Type C tapper the motor is stationary; drive of tap is through Vee belt and multi-speed pulley. Compressed air, controlled by an automatic air valve, furnishes pressure for both tapping and reversing strokes of tapping head. The automatic valve also controls speed with which tap is fed

(Cont'd on page 36)

Illustrated at the right is the improved new Universal collet chuck. Release spring allows the automatic release of the tool as a nut is turned.

Below is shown the new Haskins Air Controlled Tapping Machine. It has a capacity of from No. 8 to 5/16" in steel and ⅜" in brass. This machine is also adapted to feeding into a simple holding or magazine fixture as well as hopper or dial feed or other specially designed fixtures.



Production Perspectives

News of Mass Manufacturing from Everywhere

As this page goes to press the Chrysler strike in Detroit has been settled. **To the 55,000 Chrysler employees, some 15,000 Briggs body employees and many other thousands of employees in Chrysler supplier plants this is joyful news. Effects of this dispute, the longest in the history of the automobile industry (54 days) were felt throughout the nation.** It heralds a return to full time operations for the entire automobile industry and prosperity for the six and one-half million people who look to the motor industry for their support.

Other mass manufacturing plants throughout the country, representing other industries, however, **have been apparently unaffected by the Chrysler strike** and **the lack of a sufficient number of skilled mechanics is still being felt in all sections.** In the Western Massachusetts industrial area, boys from trade schools are being hired just as quickly as the school is willing to release them as qualified.

In Worcester the acute shortage of skilled mechanics has caused machine tool plants to canvass the records of employees over the past fifteen years and to urge them to return to their old jobs.

Orders from European countries have **caused considerable increases** in industrial productions **throughout New England.** In a few cases the orders have been made directly by foreign government agencies. A **principal order received by a New England manufacturer was the two million dollar contract for five thousand motorcycles given by the Republic of France to the Indian Motorcycle Company, Springfield, Mass.** The contract in itself greater than the company's total business last year **will provide the best period of business the concern has experienced the last ten years.** The machines will be used by the French army.

Nearly four hundred million dollars in plane orders have been placed or are pending. Machine tool and parts manufacturers have benefited from this business. Officers of the Perkins Machine & Gear Company in West Springfield said that the concern has been kept busy in the production of a good sized gear for use in airplane motors. **Bronze, aluminum and magnesium castings for airplane and machine parts are also being manufactured** by the Springfield Bronze & Aluminum Company **for American manufacturers who hold foreign, as well as American airplane contracts. Throughout the Eastern and middle Atlantic section metal processing plants are operating full time, many with two shifts and more than a few with three shifts.**

Railroads also are making extensive purchases and investing huge sums to repair or rebuild existing equipment. As an example, **steady employment for the next two months on a six day per week schedule was assured employees of the Boston and Albany Locomotive shops at West Springfield, when notices to that effect were posted by Shop Superintendent Ashley L. Wright.**

Barring this country's participation in a war **production in the country's arsenals is likely to continue at an increased rate—particularly production on the new semi-automatic rifles.**

Lewiston - Auburn, Maine, payrolls have shown increases over each succeeding month and for the same month of last year.

Payrolls in Rhode Island manufacturing plants are 17.9 per cent larger in October than for the same month of 1938.

J. Harvey Chandler, formerly Secretary of the Baltimore Chapter of American Society of Tool Engineers, and **formerly with the Glenn L. Martin Company, has joined the Chase Brass & Copper Company at Waterbury,** Connecticut, **as plant superintendent.**

The Fox Engineering Company, 1336 Francis Street, Jackson, Michigan, **was incorporated on October 1,** 1939, to succeed the Fox Machine Company, which has been liquidated.

The Company announced that it had acquired all patents, patterns, engineering data and sales records of the Fox Machine Company and that it is **continuing the designing and building of machines of the type built by the former company, and also the servicing of all machines furnished in the past by the Fox Machine Company.**

This new company is supported by a personnel having many years experience in drilling machine and press manufacture.

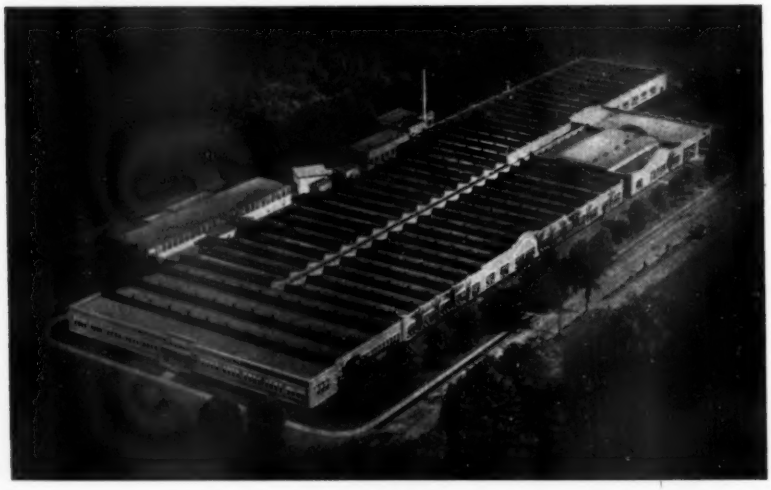
Steel mills, as well as tool and die shops, machine tool plants and in fact all metal processing plants of St. Louis area are extremely busy these days. Logansport, Indiana, plants are working full time and more—especially the plant of the Logansport Machine, Inc., which is working at full capacity and at least on one Sunday when this editor traveled through there recently.

H. P. Preis, president of the H. P. Preis Engraving Machine Company, Newark, N J., died November 2nd, 1939. The Allegheny Ludlum Steel Corporation has announced the appointment of J. M. Tull Metal & Supply Company, Inc., 285 Marietta Street, N.W., Atlanta, Georgia, as their tool steel representative in the state of Georgia. Adequate stocks of Allegheny Ludlum Tool Steels will be available to the trade through the Tull warehouse.

The present favorable tungsten situation largely brought about through government effort to encourage long range development of the American tungsten industry has caused the Firth-Sterling Steel Company to announce a "no increase in prices for 1940." The company issued a statement as follows:

"With the assurance of adequate domestic raw materials and since the price of tungsten is a principal determinant of the finished tool steel cost, we are able to peg the price—with the proviso that wage rates in the tool steel industry remain at present levels.

Increased manufacturing facilities with numerous new plant buildings or additions are reported from many sections of the country. Continuous expansion of the business of Jones and Lamson Manufacturing Company, Springfield, Vermont, required increased space for production lines with more space for administrative, clerical and engineering departments. The plant and new additions, shown below, cover four and three-quarter acres.



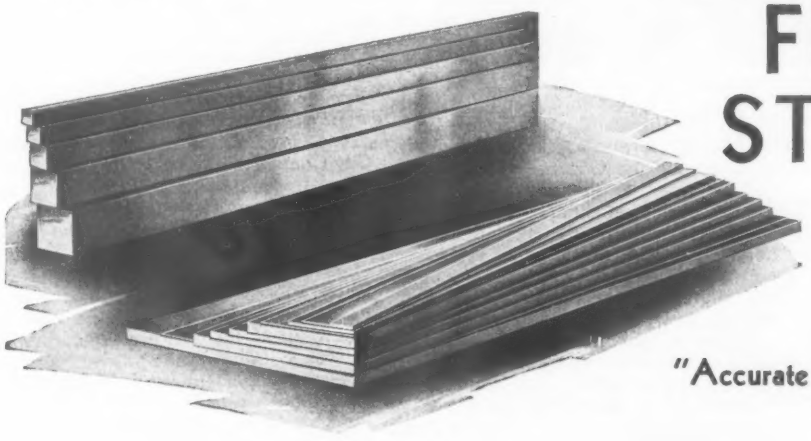
HOW MUCH CAN *YOU* SAVE?

ON PARTS LIKE THESE

TEST TOOLS	PUNCH DIES
DIE WORK	FLAT GAGES
JIGS	TEST GAGES
FIXTURES	SNAP GAGES
PARALLELS	STAMPS
MACHINE PARTS	CUTTERS
SHIMS	TEMPLATES

Save valuable time making these small parts. No hunting for stock, no grinding to size — just lay out the part and go ahead. Starrett Ground Flat Stock No. 495 comes in 18-inch lengths in a complete range of widths and thicknesses. Made of high grade tool steel and ground to within .001" in thickness, it is carefully annealed for easy machining. Each piece individually packed and marked for quick identification. Carried in stock by your Mill Supply Dealer. See complete list of sizes and prices in Starrett Catalog No. 26 T. Write for a copy, also special folder on Starrett Ground Flat Stock.

Starrett GROUND FLAT STOCK



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World's Greatest Toolmakers — Manufacturers of Hacksaws Unexcelled — Steel Tapes, Standard for Accuracy — Dial Indicators for Every Requirement

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Chapter Doings

By George J. Keller

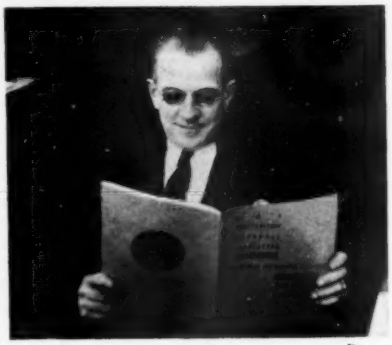
LAST month, I promised you some news—so here goes—All of you who attended the semi-annual meeting in Cleveland wondered why Ford Lamb was going around with a grin from ear to ear and why he donated so liberally to the Treasury of the "Scotch-Finding" Committee. Well—there's a lot of you old birds would probably be willing to do likewise—because—on September 24th, Ford R. Lamb, Jr. weight 7 lbs. arrived at the home of our Honorable Executive Secretary. If you'll refer to the November issue and look up some of the dates there and compare it with 1939, you can readily see why he was in such a jovial mood.

Took a little jaunt down East last month and lo and behold who should I see in the wee hours of the morning in the Springfield, Mass. depot? None other than Roy Bramson. Saw Mr. Charles Van Norman who was a Tool Engineer when most of us were wearing safety pin shorts. Journeyed on to Worcester for a day at the Norton Co. where I saw Bob Lippard also Ray Cole of the Worcester Chapter. Glo Temple from Toledo dropped in on me for a day.

Otto Winter is sporting a mustache. I'll let him tell you why? While in Worcester saw some interesting movies of Hawaii and Japan. Can readily see why tired executives, who can afford it, go there to rest their shattered nerves. Thought all of you would be in the fold this month, but of course, you can't make me mad. The less you send in, the less I'll have to do—so here goes—with what I've got.

Dayton Chapter met on November 13th at the Engineers Club and believe it or not, Jim Weaver was present. He gave a splendid talk on the activities of the A.S.T.E. nationally and the outlook for 1940. Jim brought with him Messrs. Whipp, Dull, Abe and Raterman of the Monarch Machine Tool Company. They were a welcome troup indeed, as were the ten men from Black and Clawson headed by Henie Pippert and Tompkins. Oh, Yes Henie Nickels and Walter Wise of Frigidaire were there, too. We also learned that "Whitey" Poock likes stag dances. Hurrah! for Carmony and Folkerth—they brought in six new members from International Tool. The technical talk by Dr. A. A. Bate of Westinghouse Research made very clear the Tool Engineer's place in metallurgical problems. By the way, Dayton has a big dance on December 8th.

Cleveland Chapter held its November meeting at the usual spot with approximately 75 members attending. They were given an excellent talk by Art Hopcraft of Cleveland Worm and Gear on the "Sales Engineer and the Purchasing Agent," which was amusing and yet full of good business ethics. Good old Fitz furnished the entertainment in the form of a tricky female roller skater and a male xylophone artist. H. P. Wilkinson, National Acme Company, gave an illustrated lecture on "Reclamation of Cutting Oils" which was well received and a lengthy discussion period followed.



Here you see Editorial Chairman George J. Keller of Buffalo. We knew his hair was thinner "on top" since taking over this job, but he still wears the big smile we all know him by.

Toledo Chapter held its November 7th meeting at the Toledo Yacht Club. Following a grand chicken dinner, the technical session was opened with Mr. M. A. Weckerly, of the Toledo Scale Company, speaking on "Industrial Scales as Control Tools" and closed with a lively discussion on "special scale installations." The December meeting will include a trip through the Page Dairy Company plus a movie, "Romance of Diamonds" which will be given by Sidney Kimball. A lunch will be served afterwards. This picture will be the berries due to Christmas being so close and the fact that this meeting will be open to the wives and lady friends of the members. Bob Haynes has been pretty busy lately and we are hoping he will be able, in the near future, to attend our sessions again. Glo Temple was in Buffalo recently on business, we hope.

Baltimore Tool Engineers were in their glory at one of the biggest meetings of the year, a joint session with the A.S.M. Washington and Philadelphia were ably represented. Mr. A. H. d'Arcambal, Pratt and Whitney Co., presented an educational talk in a manner interesting and easily understood by everyone. Approximately 175 members and friends attended the technical meeting preceded by a dinner for 75. Baltimore's third annual dance will be held at the Lord Baltimore Hotel the evening of December 9th and they anticipate a record attendance.

The boys of **Milwaukee** Chapter were surprised to see George Smart and are happy that he is making his home there again. "Katrinka" Schwartz, "Transportation" Papke and "Machinery" Bill will pilot Milwaukee Chapter's annual frolic to be held in January. They are hoping that Mr. Schwartz will give them some of the techniques on the Katrinka model he saw at their last convention. Foster Koehn, who conducted the last meeting certainly must have been impressed by the Sales Department, as to the value of the Falk product. Sid Hall enjoyed his vacation but returned with the sad news that they couldn't have their southern chicken. What is it, Sid, was the wife along?

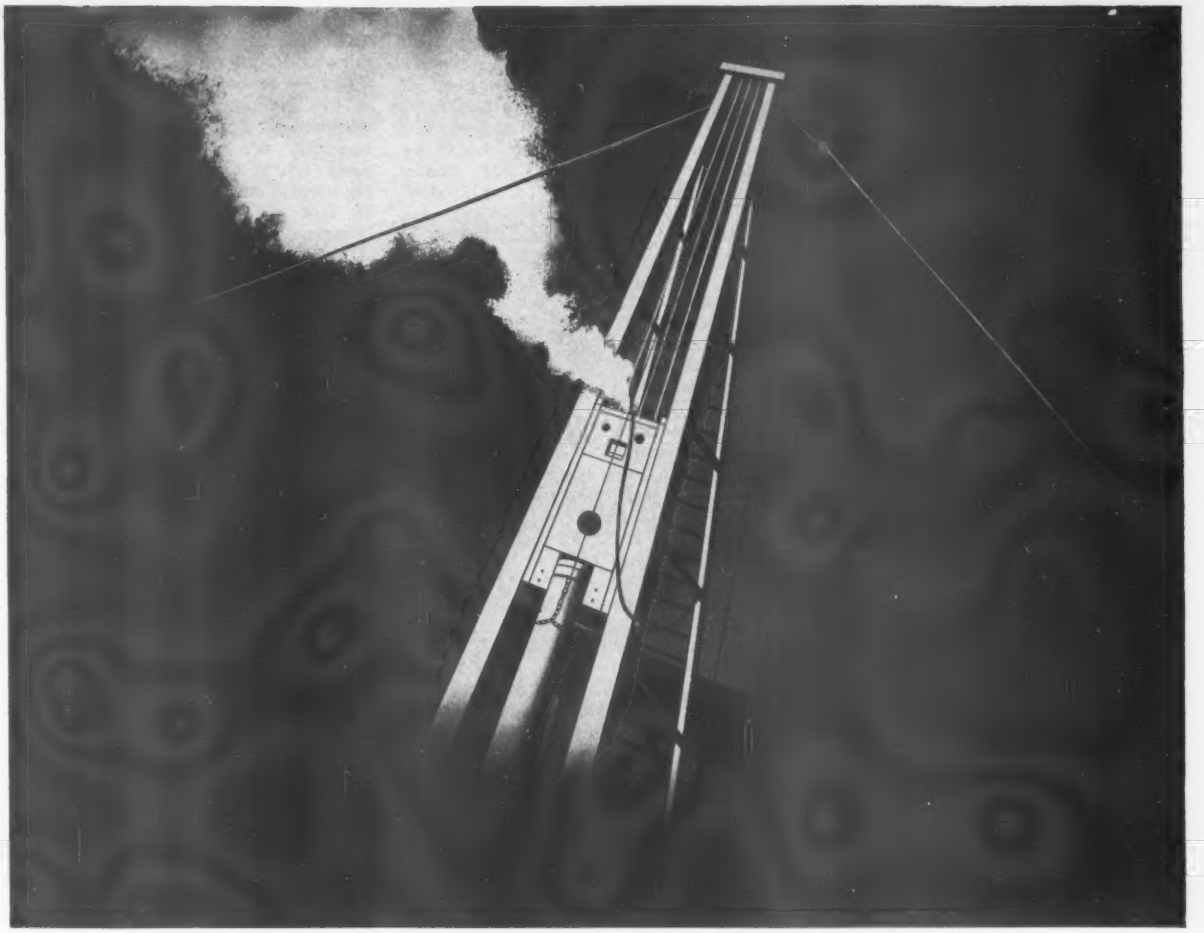
A duck dinner, a sound picture the "History of Baseball" and an illustrated talk on "Turret Lathe and Automatic Lathe Tooling" by George Class of Gisholt Machine, brought out a record crowd for the November 1st meeting of **Tri-City** Chapter. Everyone stayed for the entire evening. The only thing that didn't last was the duck. Saw slides on lathe tooling for every kind of a job from Crosley car crankshafts to airplane fire extinguisher cylinders. Had a lot of fun out of the baseball picture especially the way it was originally played. Did you know the game started before the "Civil War" days? No one had to bring their own duck.

York Chapter held their November meeting at the West York Inn. Mr. Millard Romaine, of the Cincinnati Milling Machine Co. gave an interesting talk on "Selection of Tooling Equipment with Examples of Modern Tooling" which was illustrated with lantern slides and a lively discussion followed the talk. A motion was passed by the Chapter to issue a monthly paper giving announcements and chapter doings which is hoped to bring out a better attendance and create new ideas among the members.

The November meeting of the **Twin-City** Chapter was a bang up affair. Sixty members and forty guests attended. Out of town guests were: Harry Knopke, Milwaukee Chapter and L. E. Phelps of Racine Chapter. What has become of K. K. Roby, ex-Chairman and Gene Huot, Vice-Chairman. They have not been around for a long time. G. A. Sandborn of the Fellows Gear Shaper Co. gave a very interesting talk on "Developments in Involute Gearing." Preceding his talk he read a very interesting poem concerning the length to which designers go to make it tough for Tool Engineers.

Over 150 members and guests of **Detroit** Chapter attended the November 9th meeting held at Hotel Webster Hall. Two versatile entertainers who sang, played the accordian and guitar added zest to a fine turkey dinner which included everything from soup to nuts. The Detroit Community Fund presented sound pictures explaining the work of the organization; there was no soliciting. Mr. Guy Bates, General Motors Institute spoke on "Better Methods Start with the Tool Engineer." His talk was illustrated by moving pictures. It was especially interesting to note the en-

(Continued on page 30)



PILE DRIVERS CAN'T CALL "TIME OUT"

When a pile driver goes to work time is generally the essence of the contract, with penalties for non-fulfillment an ever-present threat. Hence the ability to give continuous service under difficult conditions and with a minimum of attention is an essential requirement. That, in turn, depends largely on the choice, for each part, of the material best adapted to the job.

One manufacturer, whose pile drivers have made an enviable record for trouble-free performance, guards dependability by making the ram piston — a vital part — of Nickel-Chromium-Molybdenum Steel. This steel develops to a high degree the particular combination of toughness, strength and hardness, in the heavy sections used, which is necessary to withstand the rigors of the service.

A re-check of your own materials specifications may disclose possibilities for increasing dependability by the use of Molybdenum Steels. You will find our technical booklet, "Molybdenum in Steel", helpful. It will be sent free on request.

PRODUCERS OF MOLYBDENUM BRIQUETTES, FERRO-MOLYBDENUM, AND CALCIUM MOLYBDATE

Climax Molybdenum Company
500 Fifth Avenue New York City

MOLY

QUESTIONS AND ANSWERS

(Continued from page 19)

hold of 650,000 of those, and the bearing has now been on the market some five or six years, so that I am sure, unless people found the use for it they would not now be buying at that rate.

I, personally, have found it a very good bearing for a great many little things—I don't want to make this a sales talk, but that bearing justifies its existence, both due to its very thin cross section and due to its low initial cost, and relatively high load-carrying capacity for the type it is.

MR. KARL L. HERRMANN: Might I have an opportunity to clarify that a little bit? I think Mr. Ewart omitted saying that both ends are turned in and the bearing is only closed after the roller is put in place.

MR. EWART: That is true.

MR. HERRMANN: Also the case-hardening is most carefully done, and the cyanide hardening department is most carefully checked, so that you have about one-third depth on each side, and the cracking of the case was a very serious problem until absolute uniformity was obtained in connection with bending over that last little bit.

CHAIRMAN HAWKEY: We are fortunate in having with us at this time, and I would like to impose on his good nature, the Chief Engineer of the Federal Mogul Corporation, Mr. John Willi. Mr. Willi, would you mind giving us a few words, please?

REMARKS

MR. JOHN WILLI: Mr. Chairman and Gentlemen: The papers this morning have been particularly interesting to me because my "quaint" way of making a living has to do with the design and manufacture of plain bearings. Probably I favor the plain bearing a little more than the roller bearing, but one must recognize the fact that the ball and roller bearing manufacturers have done a really marvelous job of making it easy for the average mechanical draftsman or designer to work these types of bearings into his layout.

Their catalogues have been handbooks of design, and competent sales engineers have been ready and available at all times to help with these problems. So because of what has been available in engineering, it has been and still is comparatively easy to work with ball and roller bearings in the drafting room.

The popularity of the so-called anti-friction bearing became very important at a time when the plain bearing seemed to have reached the peak of its possibilities, and really there was no good reason why a plain bearing built twenty-five years ago should be satisfactory in the heavy duty operations that we are confronted with today. That bearing twenty-five years ago was scraped or burned in over its shaft. It was very sketchily lubricated, usually by an oil can or, if it was lucky, it had some sort of drop feed lubricator. If any grooving system existed, it was based on what the individual designer thought he would want to get around in if he was a quart of oil (laughter) and so on down the line.

Now this plain bearing picture was, and still is, complicated by the fact that there were and are a very large number of manufacturers of plain bearings and plain bearing materials. Some produced a limited line of lined bearings. Others produced bearing bronzes in the form of castings or bars to be fabricated into bearings by the purchaser. Others produced only a line of white metals or Babbitts for lining purposes. I can think of not more than two or three manufacturers of bearings and bearing materials who at the moment produced anything like a complete line. The remainder are more or less specialized along certain individual lines, but I am very much afraid that each specialist has tried to make his particular product, which necessarily has a certain and more or less restricted field of usefulness, fit into any and all applications.

Twenty-five years ago, to mention an arbitrary figure, a machine builder took practically full responsibility for the design, manufacture and the success of his plain bearing, and when he started to get into trouble, it was simply natural for him to react to the then very apparent advantages of ball and roller bearing and the engineering assistance which went along with it.

In the automotive engine it has been a necessity that plain bearings be developed to a high point of efficiency. After all, these other types haven't worked out very well, and this efficiency business must be considered not only from the standpoint of metal combinations, but engineering features of lubrication and oil distribution within the bearing, oil clearances, and finally, and really most important, is the definition and understanding of the proper fields of usefulness of the various available bearing materials, and the conditions under which each type of material functions to best advantage.

Now in engine work, which has been mentioned before, interchangeable plain bearings are practically universally used, which makes replacement comparatively simple. Running speeds of 50 feet per second and upward are common. Maximum bearing pressures of 2000 to 3000 pounds per square inch also are common, and in aircraft engines pressure as high as 5500 to 7500 pounds per square inch are frequently met.

I think it is very important, when we are considering plain bearings, to recognize definitely the fact that there is no universal bearing material good for any and all installations, that each type of bearing material demands its own set of design and operating conditions, and if those conditions are not met it results in plenty of trouble.

The statement is ventured that no doubt many cases of trouble involving so-called anti-friction bearings are the result of the consideration that a bearing of this character is capable of universal application, trying to make it do a job for which it is entirely unsuited, and we can have just as much trouble of that character if we play with plain bearings. Undoubtedly there are faulty roller bearing installations where a properly designed plain bearing would be an improvement functionally and at less cost, but a successful installation will not be obtained just because the bearing is plain, nor can success be obtained by writing to a bronze or Babbitt manufacturer and saying, "We have a shaft three inches in diameter, turning over 1500 revolutions per minute. What material do you recommend?"

A successful bearing in any machine is the result of proper coordination of metallurgy and engineering, and it is about 50 per cent of each. The development and success of the so-called plain bearing and the automotive engine has been possible because of very close cooperation between the engine builder and the bearing manufacturer, and the same sort of cooperative effort must exist in working out the bearing installations for other types of machinery. Thank you.

CHAIRMAN HAWKEY: Thank you, Mr. Willi.

"Tempus fugit" with five minutes to go until one o'clock.

ANTI-FRICTION BEARINGS

(Continued from page 12)

self-contained and ready for installation and are useful not only as cam followers, but also as table guides, gibs and rollers in general.

Slide 5

Another interesting type for which there is a demand in the machine tool field is the ball reciprocating bearing which allows its shaft to reciprocate axially while rotating. This bearing consists of a series of balls set spirally in a cylindrical cage, the balls of which operate between an inner and an outer cylinder, both of hardened steel. This type of bearing is used in gear lappers and gear generators, polishers and wherever a combination of radial and axial motion is required.

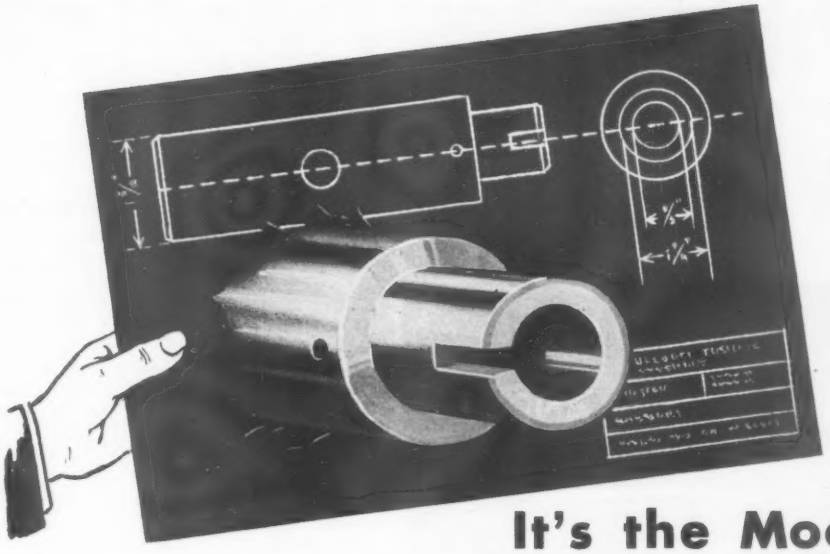
Still another type of bearing which finds a place in this field is the ladder bearing which consists, as you will visualize from its name, of a series of rollers lying between and retained by the rungs of a miniature bronze ladder.

Bearings of this type are used under oscillating tables and as frictionless bearings under sliding heads. They are also used in transfer mechanisms for automatic thread cutting, their value lying in the fact that their static friction is very low, which contributes to accuracy in starting and ending the machine operation.

Conclusion

As there are exceptions to all rules, so there are, to many of the statements in the foregoing.

When Your Specifications Demand Straight, Round Holes



Use SUNNEN HONING!

It's the Modern Method that Positively Corrects Errors of Taper and Out-of-Roundness to .0001" Limits!

A Low Cost Machine with Guaranteed Accuracy

Easy to Operate and Control.

Effects Production Efficiencies.

THE Sunnen Precision Honing Machine will produce supersmooth surface finishes and correct errors of previous machining to a .0001" limit of accuracy *in the same operation.* This is made possible because of the three-point design of the Sunnen mandrel—using one single, abrasive stone supported by two parallel, unevenly spaced, solid guide shoes. With this design, cutting can only take place on the high spots or smallest diameter first—no stock is removed from the largest diameter or low spots until the hole is *round and straight.* That's why more and more manufacturers whose specifications demand straight, round holes are using Sunnen honing.

Take for example the nitrided steel Diesel Engine Fuel Injector Cylinder shown above. The manufacturers of these important units use Sunnen Precision Honing Machines because, in addition to their simplicity of operation, they provide the only practical, low cost, production method for securing the extreme accuracy necessary for this class of work.

Hundreds of manufacturers of such parts as gauges, drill jig bushings, bearing races, automatic machinery, hydraulic cylinders, clevises, gears, valves, gyroscopes, instruments, pump parts, etc., are now using Sunnen Precision Honing Machines to correct errors, maintain alignment and finish their holes to extreme limits of accuracy and smoothness.

The Sunnen Precision Honing Machine is ideally suited for assembly operations, repair and salvage work, short run production, tool room and experimental work and for the job shop.

Write today for the new 8-page bulletin giving complete information.

SUNNEN PRODUCTS COMPANY

8002 Manchester Avenue, St. Louis, Missouri

SUNNEN

Sunnen Model "MA" 4-Speed PRECISION HONING MACHINE

CHAPTER DOINGS

(Continued from page 26)

thusiastic group of Junior members who attended this meeting.

Two hundred and twenty-five members and prospective members of **St. Louis** Chapter were guests of the Carter Carburetor Company on November 9th. An interesting illustrated lecture on the evolution of the carburetor and a tour of the big plant in operation were the big events of the evening. They went through all the departments in groups of ten with a company foreman or engineer to conduct and explain all operations to each group. A long, serious, interesting session was topped off with a fine midnight supper and good St. Louis Beer, all provided by our host. To date this was the most successful meeting.

W. A. Hart, Chief Engineer, Colonial Broach Co., Detroit, was kept on his feet 45 minutes answering questions after he delivered his talk on broaching tools and fixtures before the **New York-New Jersey** Chapter on November 14th. The meeting was held in the Robert Treat Hotel, Newark. About 300 members and guests were present at the meeting but Herb Hall would have liked to have had more out for the dinner. Next month, Raymond V. Havican of the Scoville Mfg. Company is to talk on motion study applied to jig and fixture design.

Hartford is steadily moving in the right direction. An increase in membership is being recorded and they are getting fine turnouts for their meetings. On November 6th about 300 came out to hear R. T. Keller and A. M. Swigert of the Chrysler Corp., give a fine talk on "Superfinishing." Samples of the work and moving pictures made an interesting evening. At the dinner meeting preceding the technical session Mr. Everett D. Packard, director of the Hartford State Trade School gave a timely talk on preparing young men for industry. The system of each member wearing a button with his name and business is proving popular. It makes it easier to get acquainted.

The first joint dinner of **Los Angeles** Chapter of A.S.T.E. and A.S.M. was held on the 6th of November with 140 members and friends attending. A. H. d'Arcambal, First Vice-President A.S.T.E., gave a lecture on "Gauge and Cutter Manufacture."

Over 100 attended **Ontario** Chapter meeting in Hamilton on November 10th. E. W. Faulkner, Federal Machine and Welder Co., spoke on "Welding for Tooling Purposes." Watch this chapter. They are really going places.

Syracuse Tool Engineers held their November 14th meeting at the Syracuse Industrial Club. 39 attended the dinner and 89 turned out to hear Herman Goldberg of the R. G. Haskins Company discuss "Taps and Tapping." Mr. Goldberg brought with him a precision tapping machine on which actual operations were performed to illustrate his talk. It was a fine lecture and everyone enjoyed it. A number of the Syracuse crowd were all set to go to Cleveland to the Tool Show and when it was called off they just wouldn't be beaten so went in the opposite direction to the Vermont Regional Tool Show. They all came back full of enthusiasm for the new things they had seen.

Schenectady Chapter meeting for November was held at Rice Hall of the General Electric Company. Mr. Herman Goldberg of the R. G. Haskins Co. gave an interesting talk and demonstration on "Taps and Tapping Machines." The meeting was enlivened by many questions from the audience and evidently the subject was of considerable interest to their members. Approximately 150 members and guests were present. There was also a good representation from the Gurley Instrument Co. of Troy, American Locomotive Co., of Schenectady and the Watervliet Arsenal.

The most interesting meeting of the season was attended by 60 members and guests of the **Buffalo** Chapter on November 16th. Herman Goldberg, of the R. G. Haskins Co. gave one of the finest talks and demonstrations on Taps and Tapping Machines ever given before this group. "Reservationless" Bill Gamble was on the job and Fred Manthai came in to look us over. Come more often, Fred, we miss you. Lockport was conspicuous by its absence.

(Continued on page 40)

Now.. MAKE PRECISION TOOLS AND DIES IN A SINGLE SET-UP.. More Rapidly More Accurately

- Milwaukee Rotary Head Tool and Die Milling Machine — provides speed, economy and accuracy in precision tool and die making.
- Completes precision tools and dies at one set-up.
- Saves time — increases accuracy . . . layouts, milling, drilling precision boring and slotting operations without resetting machine.
- Send for Bulletin No. 1002 giving complete information.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WISCONSIN

You Can Get IMMEDIATE DELIVERY On These Low Cost Drill Presses

$89.50
with motor pulley and belt but without motor

Yes–you can get them at once–in 11", 14" and 17" sizes–bench and floor types–single or multiple spindle models–at prices from ⅓ to ½ of ordinary equipment. They are being used in thousands of industrial plants singly, in batteries, in standard set-ups and in hundreds of special set-ups. They can be used in any position—vertical, horizontal or at any angle—because their self-sealed ball bearing construction eliminates lubrication problems. Their low cost makes them more economical than anything that can be made up in tool rooms or machine shops.

MANY SPECIAL FEATURES

Five speeds: 385, 600, 935, 1450, 2240 R.P.M. Floating Drive; Preloaded double-seal ball bearings; 16 tooth splined spindle; Table Raising gear; Head-Raising gear; Tilting or production table; Completely enclosed belt; Safety spring wind; Foot power feed. Overall dimensions 66" high; 18" wide; 27" front to rear. Tilting table 11" x 12". Production table 12½" by 17" surface. Floor base 10" by 13¾" table surface. Shipping weight 340 lbs. Separate drill press heads available. Also high speed bench models and 2 spindle models.

Send for NEW DELTA CATALOG

Mail coupon for latest Delta Industrial Catalog. It contains specifications and prices of complete line of Delta Drill Presses plus details on individual parts from which you can make your own low-cost assemblies.

DELTA MANUFACTURING CO.
Industrial Division
648 EAST VIENNA AVENUE
MILWAUKEE, WISCONSIN

Delta Mfg. Co. (Industrial Division)
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Gentlemen: Please send me your latest Delta Drill Press book which contains specifications and prices of your complete line of Drill Presses.

Name .....

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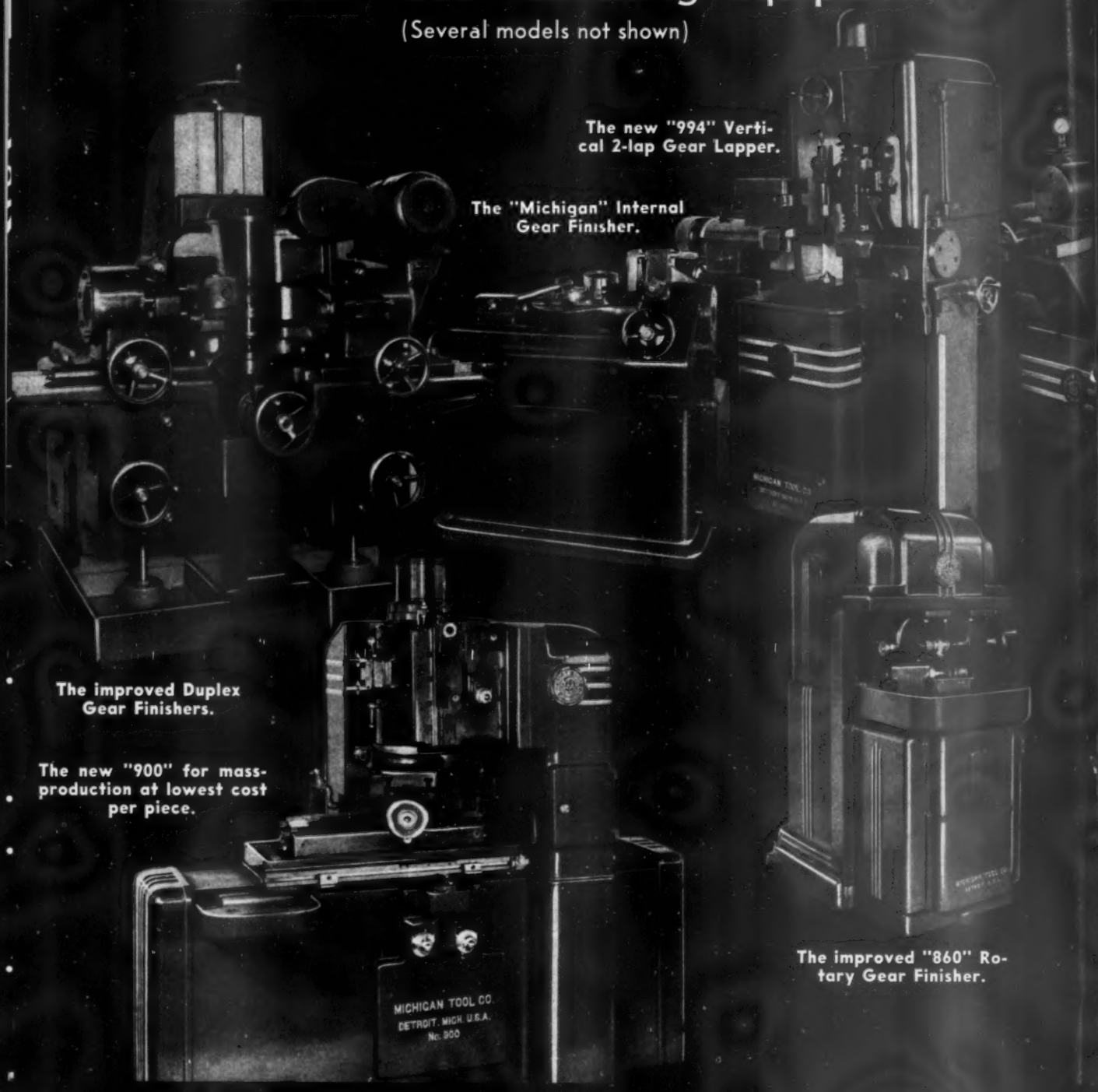
Better Gears? Here is

The Complete New Line of "Michigan" Gear Finishers, Gear Lappers and "Sine-Line" Gear Checking Equipment

(Several models not shown)



The new "994" Vertical 2-lap Gear Lapper.

The "Michigan" Internal Gear Finisher.

The improved Duplex Gear Finishers.

The new "900" for mass-production at lowest cost per piece.

The improved "860" Rotary Gear Finisher.

your answer...

The New "995" Horizontal 2-lap Gear Lapper.

Improved, faster, "Sine-Line" Lead Checker.

The "Michigan" Gear Speeder.

The improved "Sine-Line" Involute Checker.

Michigan 3-lap Crossed Axis Lapper.

The "860A" Rotary Gear Finisher for job lots.

2 Reasons why more gears are finished on Michigans than on all other makes combined:

1. Michigans produce better gears at LOWER cost;
2. There's a model to fit virtually every production set-up.

(Catalog on Request)

Ask us about "Curve-Shaving" (Bulletin No. 150) and "Cone-Drive" Worm Gearing (Bulletin No. 148).

MICHIGAN TOOL COMPANY

7171 E. McNichols Road - - - - - - Detroit, Michigan

Handy Andy Says —

FOR several years, I have been preaching training of youngsters in the skilled crafts, as tool and die work. But apparently, mine was a voice in the wilderness, unheard and unnoted. Ambitious boys wrote to me, asking for help, and I approached employers in their behalf, but to little avail. They agreed with my views, commended the ambitious but just put it off. "We just haven't facilities for training." But now the situation is becoming acute; there is a shortage of skilled men and industry is waking up to its needs, spurred perhaps by the technical press. Well, it is time; the skilled worker has ever been a force in industry and in the community in which he lives. We need more of them.

▼ ▼ ▼

When I first started to mention our advertisers (their names stirred reminiscence in connection with former employment) there weren't so many names in the index. But as the Society grows and the circulation soars, advertisers increase so that I find I've a job cut out for myself. Oh well, good will and patience; fortunately, I am acquainted with most, if not with person, then with product, so we'll continue the game. But you know, we're a queer lot, we Tool Engineers, in that we take ourselves and the things we create too much for granted. For instance, we read the ads, then, instead of direct inquiry, to headquarters, we just call up the local representative (he's a member, likely as not) and tell him to drop in. I do it myself, although I usually peruse the ads and new equipment items. But if something interests me, for instance, I'll just call the representative and he's out to my office within the hour. Never a mention of THE TOOL ENGINEER, despite that I saw it there. It's all taken for granted.

▼ ▼ ▼

One concern I've had in mind for some time is Potter & Johnston of Pawtucket, R. I. I lived in that town as a boy, fished for crabs in the river and once took a dive off Division St. bridge, an embarrassing incident considering that the cop who tried to stop me denuded me of the bandana I used in lieu of trunks. (Tights, they called 'em in those days). Well, I've driven past the P. & J. plant many a time since then, and while I've never stopped in, the sight of the ivy covered buildings always stirs a sort of "acquainted" feeling. Due, no doubt, to having used P. & J.s so much. They're producers, those machines, good when I was a youngster and as modern as tomorrow to this day. I knew the Oden brothers, especially Nels, who used to travel around setting up and demonstrating. I remember Nels well, a likable chap with a mischievous eye, a ready smile and a yen for pretty girls. (He married one, I believe.) Well, if any of you boys run across Nels give him my regards. Out of sight doesn't necessarily mean out of mind.

▼ ▼ ▼

Speaking about pretty girls reminds me that my wife came from Worcester (tarrying awhile enroute from "over there"), present home of Bob Lippard and one of our newer Chapters. Saw Bob at Cleveland, and he looks about the same as when I first met him. That is one thing about these national meetings, that time flies fast between 'em and the boys grow older slowly and gracefully; a deepening wrinkle, perhaps, and a few hairs less, but otherwise the same. Talked with genial Dave Forsman a few days ago (he's with Michigan Tool) and found that his boy is settled in Worcester, employed by Norton. A fine concern for an up and coming chip off the old block to connect with. Gosh, how these youngsters grow up!—get into their stride! Do you remember when Time lagged on leaden feet? Well, it flashes by on golden wings, now. Oh no, not that: we still scale the hill and the crest is in the clouds.

Heard at the Semi-Annual, from Minneh-uh,-sota: "Ay can say Jam yust as gude as you. Only, by yiminy, Ay

(Continued on page 38)

R-S Model B Collapsible Tap, Stationary Type (illustrated), also available in Revolving Type. External Trip Micrometer-adjusted by knurled ring.

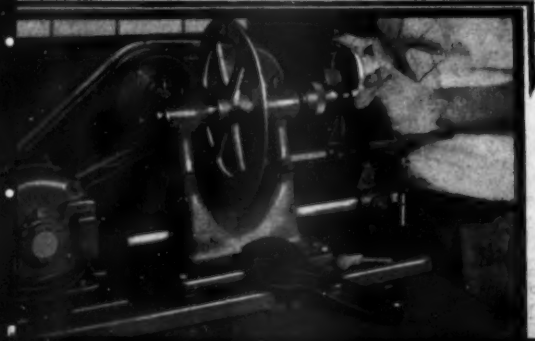
R-S Semi-Automatic Threading Machines—Double spindle type (illustrated) for spark plug and similar second operation threading, also made in single spindle type.

The RICKERT-SHAFER Co., Erie, Pa.
Specialists in ACCURATE THREADING at GUARANTEED LOW COST
DIE HEADS ▼ TAPS ▼ CHASERS ▼ BORING HEADS
THREADING, TAPPING AND CUT-OFF MACHINES

R-S Adjustable Boring Heads available in 3 sizes.

R-S 1/8" Portable Bench type Horizontal Tapping Machine (illustrated). These popular Tapping Machines are made in many sizes for Horizontal or Vertical Tapping for either bench or column mounting.

Write for data, catalogs and prices.



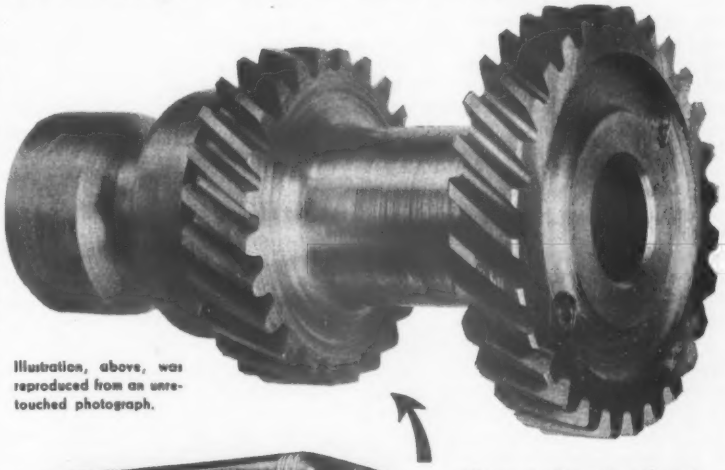
R-S Model C Die Head Revolving Type, Yoke Controlled (illustrated). Model F is the stationary type.

Tops for High Quality Production

TYPE V Barber-Colman Vertical Hobbing Machine

NEW Speed • *NEW* High Accuracy • *NEW* Fine Finish

"Best gears ever cut on a hobbing machine" was said about a lot of cluster gears shown at right as cut on Barber-Colman Type V Hobbing Machine. Unusually close limits were held, production increased 75% . . . see data at right. Finish . . . superb! Production, accuracy, finish; any one of these might have been equalled by other means, but Type V produced *all three in combination* . . . and that's tops in high quality production hobbing. What Type V is doing on gears shown, it has equalled or exceeded on others. Here are the basic reasons:



Illustration, above, was reproduced from an untouched photograph.

Unique Type V Vertical Design simplifies construction and operation, saves floor space, gives complete accessibility. Massive deep-section frame is enormously strong and rigid. Work-slide feeds upward; gravity aids rapid traverse downward, drops chips and coolant directly into chute.

Automatic Operating Cycle employs highly effective combination of *hydraulic, mechanical* and *electrical* operating means; includes conventional or climb cutting.

Quick Set-up—Speed, feed, and index gears are selected quickly, mounted easily. Simple adjustments establish work-slide movement and positive depth of cut. Central controls give individual command of cycle motions.

Investigate. Bulletin 1645 fully describes the many features and advantages that make the Type V Hobbing Machine an outstanding producer. Write, today, for a copy.

Type V Vertical Hobbing Machine.

Here is Production!

The Work: Helical gear indicated in cluster above; 24 teeth, 9.25 pitch, 0.775" face. Material: S.A.E. 5140 steel, 180 Brinell hardness.

	Former Method	B-C Type V
Feed	.059"	.070"
Hob r.p.m.	170	300
Hob diameter	3"	4"
Hob threads	2	2
Cutting time	2.20 min.	1.15 min.
Change time	.25 min.	.25 min.
Floor-to-floor time	2.45 min.	1.40 min.
Production per hour	24	42
Accuracy of involute within	.....	.0005"
Accuracy of index, within	.....	.0005"

Similar results obtained on the other gear, 28 teeth.

BARBER B-C COLMAN PRODUCTS

HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

BARBER-COLMAN COMPANY

General Offices and Plant ROCKFORD, ILLINOIS, U. S. A.

The product featured in this advertisement is now available for distribution only in the United States of America.

IT'S NEW

(Continued from page 23)

into and reversed out of part. A foot pedal unit enables operator to start or stop tapping cycles, which are under control of automatic valve. The machine will operate in continuous cycles as long as air valve is held open, can also be used intermittently by operating foot pedal and then releasing it to complete one cycle. The machine, which lends itself to feeding parts into a simple holding or magazine fixture, is also adapted to hopper or dial feed or other specially designed fixtures.

▼ ▼ ▼

Federal Products Corporation, Providence, R. I., has added to its regular line of Dial Gages, among new tools being the Model C 2 I B Indicator, a Super-sensitive gage. There is also a new Model 1200 Self-locating, two point contact, Cylinder Gage, which positively locates itself in automobile cylinders or similar bores. Federal has also developed several other gages, among them a motor operated thickness sorting gage which automatically sorts material of unknown thickness. This portends considerable interest by industry, and we hope to have full information on this tool by next issue.

▼ ▼ ▼

"The Jack that Can't Leak" is giving a dependable lift to industry, according to the makers, Pomeroy Hydraulic Jack Co., 1918 Santa Fe Ave., Long Beach, Cal. Furnished in capacities from 10 to 150 tons capacity, this Jack is said to be durable, safe, with adjustable step and controlled descent and, it can't leak. A unique expansion tank feature prevents leakage and renders it unnecessary to add liquid. An interesting, descriptive bulletin is available to all interested.

Danly Machine Specialties, Inc., of 2112 South 52nd Ave., Chicago announces a new and enlarged line of Danly Precision Die Sets in a wide range of sizes of regular, reverse and long narrow die sets for any die from 3" x 3" to 25" x 14", in many thickness combinations of die holder and punch-holder. Included also are a new "Square" series of back post sets for mounting square and round dies, also in a complete range of sizes from 3" x 3" to 14" x 14".

Danly Precision Die Sets are assembled with Precision Guide Posts and Bushings, are hardened, ground and lapped to tolerances of plus or minus one-ten-thousandth of an inch. Precision bushings, of standard, shoulder and extra long types are ground and honed to the same accurate limits, and of course are interchangeable. Any die holder or punch holder of the same center distances will fit with any other die holder or punch-holder of the same dimensions. Accurate manufacture makes available a wide variety of thickness combinations, as each Danly Set is assembled to order to the customer's specifications.

Assembly Plants and complete stocks are maintained at each of the company's eight branches. All new types and sizes will also be available in the commercial line.

A feature of the catalog, in which the new sets are announced, is a graphic chart showing the complete range of sizes of Standard Back Post Sets, making selection of the right size a simple, sure procedure.

▲ ▲ ▲

A fixture, the No. 155 Diamond Wheel Dresser, made by **Stanley Electric Tool Division,** New Britain, Conn., is now available for use with the Stanley Contour Grinder. It provides an inexpensive means of truing or dressing grinding wheels or points. A ring on bottom of fixture fits in counterbored hole in table of the Grinder, setting accomplished by a large knurled adjusting screw. Holder, in which ¼ to 1/3 carat diamond is mounted, is adjustable, while a small knurled screw provides accurate setting of diamond and regulates depth of cut.

The Stanley Contour Grinder is used by tool and die makers for finishing dies, gauges, templets and special shapes. The motor (a self contained tool adaptable to many uses) is held in a holder adjustable from vertical to 45 degree, with mounted point, wheel or rotary file projected through the table. An interesting Bulletin, describing the tool, can be had from the makers.

▼ ▼ ▼

Allen-Bradley Company, 1311 First St., Milwaukee, has marketed an improved three-button control station, designed for easy application and long life. The button mechanism is of unit type construction, mounted in a die cast box open at front and two sides, with conduit opening at one end. It is enclosed by a molded plastic cover which, removed, gives access to all connections. The control is available with various button markings, as, "Forward, Reverse, Stop," "Raise, Lower, Stop," and "Open, Close, Stop." Mountable vertically or horizontally, it may be provided with a bar for locking the "Stop" button in its open position.

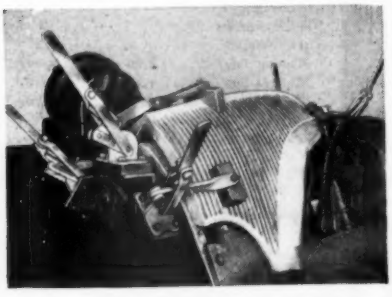
▼ ▼ ▼

The Pittsburgh Stencil and Tool Company, 749 Crafts Bldg., Pittsburgh, Pa., manufacturers of Rick Markwell Holders for stamping steel and other products, announces a new tandem holder which is particularly valuable for stamping intensely hot metals.

This double line axe-type holder, with three pieces of type in each line, when swung like an axe, is much more likely to imprint all six numbers than one with six numbers all in one line.

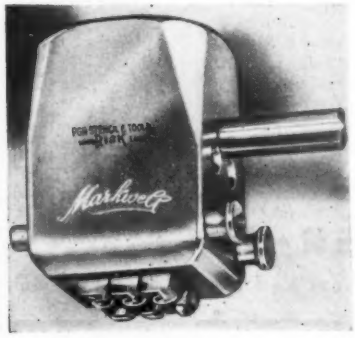
The only moving part is a sturdy pin, in each row of type, which carries its own spring. One quick motion locks it; another unlocks it.

Markwell holders, which handle type made for other holders as well as its own, employ safaloy type, a special alloy, which is practically unbreakable and makes for safe and economical stamping. Markwell holders come in all sizes from $\frac{1}{16}$" type up to 1" or larger.



Danly Machine Specialties Company now manufactures a toggle clamp of rugged construction yet inexpensive. An example of an excellent use for such a clamp is shown at the left where it is used to hold an automobile radiator grill.

Stanley Works—Stanley Electric Tool Division announce their No. 155 Diamond Wheel Dresser, shown lower right, in conjunction with the Stanley profile grinder. The new dresser provides an inexpensive means to true the dressing wheels or points.

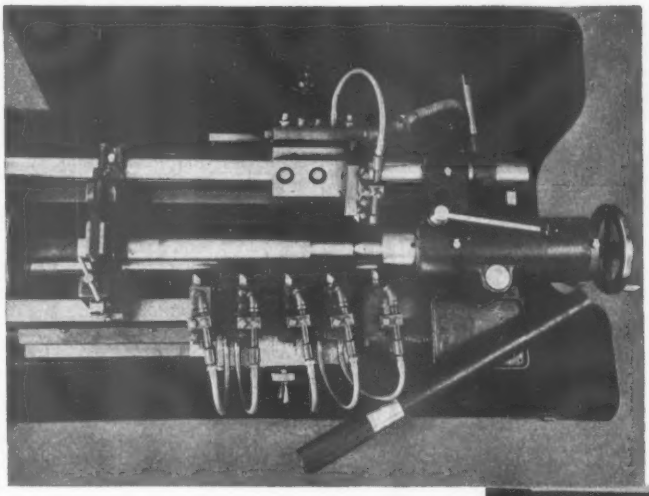


Center, left—Allen-Bradley's new improved three button control station. It is available in a wide range of markings, is mountable vertically or horizontally and may be provided with a bar to lock the "stop" button in its open position.

Left — The Rick-Markwell Holder for stamping steel and other products — especially hot metals. Comes in all sizes from $\frac{1}{16}$" type to 1" or larger. Made by The Pittsburgh Stencil and Tool Co.

Multiple Cuts *and* Divided Costs

make the FAY AUTOMATIC LATHE *the logical choice to machine work of this kind*

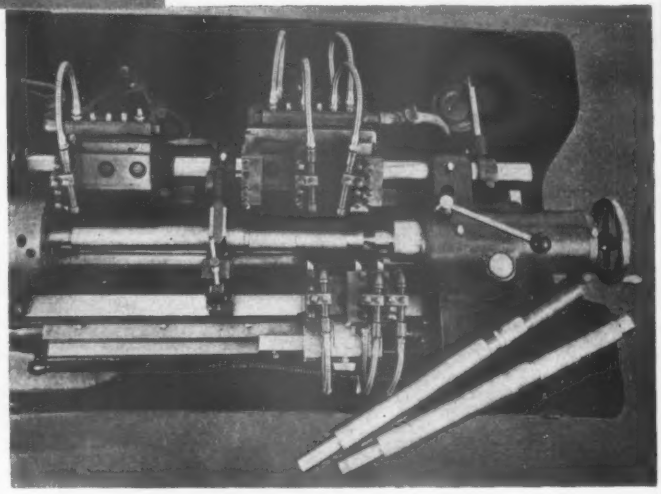


1

Here is a typical example of how Fay Automatic Lathes *increase profits* for their owners. This shaft of Hyten B2 stock 30 x 2½″ is machined all over in two 8 x 33″ Fay Automatic Lathes. One machine is used for roughing and the other for finishing, with *one man operating both machines.* Using HSS tools, a production of over 20 shafts per hour is maintained, leaving a minimum of stock for finish grinding.

2

The *ease of set-up* and *simplicity of operation* of the Jones & Lamson 8″ Fay Automatic Lathes make it possible to earn mass production profits even on small lots of work. It is *completely automatic* in its cycle, and even more than two machines can be run by one operator where cutting time permits.



Shafts in *Quantity*, or in *Small Lots*, are machined *Economically, Quickly* and *Accurately* on Jones & Lamson Fay Automatic Lathes. It should well repay the manufacturer who desires to reduce costs and increase profits to investigate the possibilities of these machines.

A *new 16-page Catalog* describing the construction, operation and attachments of the 8″ Jones & Lamson Fay Automatic Lathes is now available upon request.

JONES & LAMSON MACHINE COMPANY

SPRINGFIELD, VERMONT, U. S. A.

MANUFACTURERS OF: SADDLE & RAM TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC DOUBLE-END MILLING & CENTERING MACHINES . . . AUTOMATIC THREAD GRINDING MACHINES . . COMPARATORS . . TANGENT AND RADIAL, STATIONARY AND REVOLVING DIES AND CHASERS

HANDY ANDY SAYS

(Continued from page 34)

practise twenty years to say it, and now they call it yelly."

▼ ▼ ▼

One thought leading to another, I notice the recurring ads of Gisholt Machine Company, and oddly enough, I first became acquainted with their product through one of my landsmen, a "greenhorn" who had just come over and who had used Gisholt lathes on the other side. In Bolinder's, I believe. A roundabout way, eh, what? Anyway, a turret lathe isn't just a turret machine any more than a heavy duty production lathe is a precision tool room machine. While there are overlapping functions, most of them are designed for a certain class of work and cover that range quite thoroughly. Gisholt's specialty — among other things — is long, deep holes and concentric O.D.'s and it sure turns 'em out. That was my first use of them, on a job that had to "fit," and fit it did. And to think, a greenhorn from the other side recommended 'em. Yes, we take things too much for granted.

▼ ▼ ▼

The greenhorn—I'll call him Emil Quist, which wasn't his name—was put into my bed one night since the boarding missus had no other spot open. It was during the heyday (halcyon days, I came near saying) of my bachelorhood, and for a year and a day that bird had me going between extremes of laughter and exasperation. One evening I bought a cocoanut at a fruit-stand, asked him to hold it while I went in and paid for it. Coming out, I heard a crash, and there was the nut, spattered all over the sidewalk. "What in heckelfelt did you do that for?" I cried. "Look at the milk, all running into the gutter." "Milk?" he puzzled. "Well, so take me a thousand barrels of devils! I might have known it was some kind of critter, with that face and all that hair. Don't they have regular cows in America, or was that just a heifer?"

▼ ▼ ▼

He played one trick on me that I'll never forget, considering that I carry the scars to this day. I was taking a bath one night, and he rattled the knob. "Let me in, will you? I forgot my razor." All unsuspecting, I turned the latch, when he stepped in. Then, the son-of-a-gun dropped the house cat, the heavier for being "that way," plop into the tub! Then beat it. Well, you can imagine it! The sides of the tub were slippery and I was handy (no pun intended) so, up my bare shanks and naked flanks climbed the cat, claws digging in plenty—and plentier when I tried to pry her loose! Outraged and smarting, I dashed after him, in my fury quite unmindful that the boarding missus was entertaining the sewing circle in the sitting room. At that, soapsuds and gore camouflaged my nakedness, while speed of retreat must have made me a sanguine blur to the startled guests. When he came back, hours later, the humor of the situation had tempered my anger. But I got back at him, although that's another story.

▼ ▼ ▼

In case you don't know it, Pinckney, Mich., (that's Ford Lamb's home town) is in the movies. Yep, that's right, saw it in the Sunday paper, with a picture of the whole town gathered in the public square. And demme, if there wasn't our Exec. Secy himself, right there in front! Well, I may be wrong at that; it might have been a later edition, or someone that just looked like Ford. You 'know, my eyes are acting kind of funny of late on account of watching so many guys walk 'round and 'round in a futile circle outside of our manufacturing plants when they ought to be inside earning money. Just think!—something like $75,000,000 business lost to one corporation at date of writing, let alone some odd millions in wages. What in hell are we paying taxes to support a Labor Board for, I'd like to know!

Yours for restored national sanity,
Handy Andy

60 Pages of GAGES

to meet all your needs

More than forty different types of gages are shown in the Taft-Peirce Handbook. This exceptionally complete line includes plain and thread plug, ring and snap gages, length gages, micrometer plug gages, master discs, taper gages, universal angle gages, gage blocks, threaded setting blocks, thread-measuring wires, dial indicators. For special needs, any type of gage or gaging fixture can be built promptly on order. Standard or special, every Taft-Peirce gage is made and finished to measure the maximum amount of work per dollar of cost. If you have no copy of the Taft-Peirce Handbook . . . write for it today.

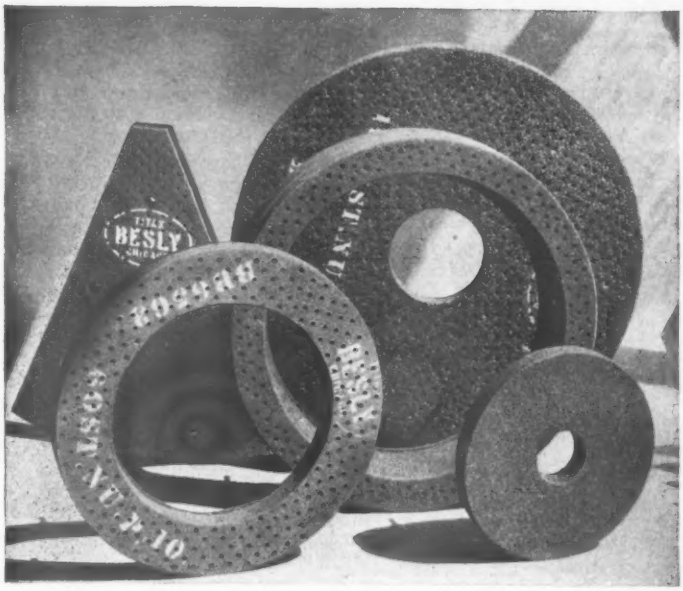
THE TAFT-PEIRCE MFG. CO.

Woonsocket • Rhode Island • U. S. A.

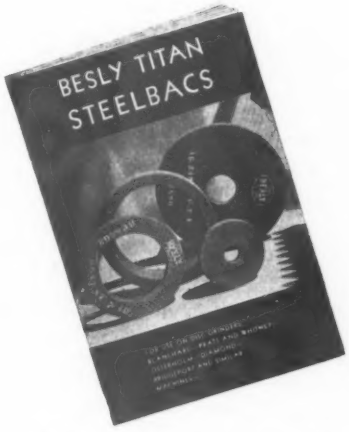
Peoria, Illinois to Have A.S.T.E. Chapter

Peoria, Illinois was granted a charter to operate chapter No. 31 on November 30th. Present from National Headquarters were Ford R. Lamb and E. W. Dickett. Officers, members and friends from nearby chapters were also on hand.

BESLY TITAN STEELBAC ABRASIVE DISCS



The list of users of Besly Titan Steelbac Abrasive Discs reads like the roll call of the world's most progressive manufacturers. • Those who are truly wide awake realize the advantages of this Bolted-On Resinoid Bonded grinding member. • Safe—Economical—Free Cutting—Long Lived—Easy to Mount—Practically No Waste. In other words, the best thing of its kind ever developed. You don't have to accept our story without proof. Try these Wheels on your Blanchard, Pratt & Whitney, Diamond, Osterholm, Bridgeport or any face grinding machine. Originally developed for the Disc Grinder but are now also widely used on these other machines. They really have merit.



Write for your copy of Booklet on Besly Titan Steelbacs.

LET US SEND YOU FURTHER PARTICULARS

CHARLES H. BESLY AND COMPANY

118-124 NORTH CLINTON STREET ★ CHICAGO, ILLINOIS

CHAPTER DOINGS

(Continued from page 30)

Don't forget our dance—February 2nd —All for Fun, and Fun for All.

Rochester members were very well pleased with Mr. Herman Goldberg's talk and demonstration on Taps and Tapping Machines. It was undoubtedly a most interesting session as evidenced by the lengthy discussion after the talk.

Sixty members and guests of **Elmira** Chapter heard Herman Goldberg talk and give demonstrations on Taps and Tapping Machines at the November meeting. An interesting discussion on the classes of fits in relation to various metals was one of the high-lights. This was the last stop for Herman Goldberg and his troubadours which include Bill Harvey.

Philadelphia held their November 9th meeting at the Engineer's Club. Mr. G. H. Sandborn, Fellows Gear Shaper Company, held an interesting discussion on gear design and controlled methods of flame-hardening gears. Slides illustrated his points.

Johnnie Strecker made the business end of the meeting short so that they might enjoy the entertainment.

The Engineers Club will be the next meeting place in December and "Chris" Christopherson has promised another top-notch speaker.

The chapter sponsored Tool & Die Design Course is being given at Spring Garden Institute, Philadelphia under the direction of Ed. Glen and has attracted considerable comment in local papers with the result that the class for this year is about filled up. Chapter members are the instructors and their practical as well as theoretical experience makes them ideal for the job.

Rockford Chapter held its November meeting on the 16th with nearly five hundred attending. Six army men from Fort Sheridan demonstrated army equipment to Rockford Tool Engineers and the Reserve Officers Association, which was a guest of the chapter. F. O. Hoagland Master Mechanic of Pratt & Whitney was the technical speaker. A turkey dinner was very much enjoyed by all. Chairman George Johnson conducted the meeting.

Baltimore's November meeting, with an attendance of more than three hundred was the most interesting and successful session to date. All thanks is due to Vice-President d'Arcambal who carried the audience in a most outstanding manner.

Approximately one hundred persons assembled at the Oliver Hotel, **South Bend,** Ind., on Thursday night for this organization meeting. Mr. E. B. Barber, serving as temporary chairman, introduced the toastmaster, Mr. Jack Ledden, sports editor of the South Bend Tribune. He, in turn, introduced Doctor (Father) Cavanaugh of the Notre Dame University, and Mr. Ford Lamb, Executive Secretary of the A.S.T.E. Doctor Cavanaugh delivered a speech of welcome and of good wishes to the proposed new chapter, while Mr. Lamb explained the aims, purposes, and ideals of the Society.

Mr. Lamb "polled" the assembly to ascertain if they wished to affiliate with the A.S.T.E. The election was by secret ballot, with the organization committee acting as tellers.

Mr. Lamb then administered the oath of office as follows:

As Chairman—Mr. E. B. Barber of Bendix Aviation Corporation; As Vice Chairman, Mr. Lestern St. Clair of Studebaker Corporation; As Secretary, Mr. John Helbig of South Bend Tool & Die Co. Home address—116 E. Broadway, South Bend, Ind. As Treasurer, Mr. Otto DuBois of Bendix Aviation Corporation.

Mr. Lamb then presented the chapter with its charter, its set of stationery, supplies, its secretary's and treasurer's journals, and its assignments of A.S.T.E. pins. After which Mr. E. B. Barber served as Chairman. He expressed his appreciation of being elected to his office, read the charter to the assembly, and made several announcements, and requested suggestions as to the meeting nights and nature of lectures desired by the group. It was tentatively agreed to meet on the second Thursday of each month, and to have educational and inspirational addresses.

TOWARD YOUR BETTER PRODUCT

the **RIVITOR**

effects a stronger riveted joint at rates up to 3200 rivets an hour and creates additional savings by making possible the use of solid rivets.

The riveting is accomplished smoothly, automatically, and with precision. The setting action is actually one of "Coining." The motion proceeds from a fast approach to the riveting position to a slower setting action—giving the metal time to flow.

The Rivitor is shown here "staking" $\frac{3}{16}$" x $\frac{5}{8}$" lg. solid rivets for reel and blade assembly.

These machines ably handle many jobs in many industries. Submit samples of your riveting jobs. We should like to show you the type of solid rivet joints that can be effected automatically. We should like you to realize savings that will help you *toward your better product.*

this is a **TOMKINS-JOHNSON** *product*

Factory at 624 N. Mechanic Street, Jackson, Michigan. Agents in principal cities. T-J products also include Air and Hydraulic Cylinders . . . Remote Control Systems . . . Rotating Chucks and Cylinders . . . Clinchors . . . Special Equipment . . . Brownie Coolant Pumps . . . T-J Die Sinking Milling Cutters.

How to INCREASE THE PRODUCTIVE CAPACITY OF YOUR PRESENT MACHINE TOOLS

. . . with one simple change

PHOTO, COURTESY WARNER & SWASEY CO.

WHEN you need more production, *FAST*—

WHEN new equipment is not immediately available—

WHEN extra man power and extra hours of work fail to meet increased demand—

WHAT WILL BE YOUR ANSWER?

If your plant has this problem to meet—and your production involves machining work—Carboloy tools may provide a means of obtaining an immediate production increase on many of your jobs.

There are two ways in which Carboloy tools can step up production on your present equipment. Reduced cutting time per piece, through higher speeds, is one way. More continuous production per hour—through longer tool life—is the other way. Either, or both, may be the answer in your particular case.

The Mark of CARBOLOY REG. U. S. PAT. OFF.

Carboloy representatives will be glad to help you get this extra capacity out of your present machines.

✓ Cut Steel with Carboloy. Send for Instruction Bulletin GT-120

CARBOLOY COMPANY, INC., DETROIT, MICHIGAN

CHICAGO • CLEVELAND • NEWARK • PITTSBURGH • PHILADELPHIA • WORCESTER, MASS.

Canadian Distributor: Canadian General Electric Co., Ltd., Toronto, Canada

CARBOLOY CEMENTED CARBIDE TOOLS

BEARING DISCUSSION

(Continued from page 18)

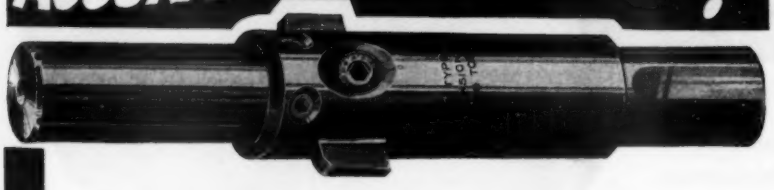
size, housing bore and width, give the designer a wide range of selection possibilities that makes for very flexible designs to suit the expected operating condition for each machine. If the bearing manufacturers could only agree on a uniform basis of rating anti-friction types, the designer of machinery would find the application and selection very much simplified. There still seems to be some mystical appeal in being able to show larger values in one's catalogue than competitors show, even if after the proper application and service factors are used, the same size bearing is selected.

Mention has been made of the progress in bearing design and application in the automotive industry as a possible guide for the machine tool designer.

When we consider the fact that the average life of an automobile may be used up in four or five months continuous industrial duty, I think we can safely say that the design practices must be widely different. We must give credit to the automotive industry for the large market provided for bearings which has justified the tremendous research expense of the machine tool and bearing manufacturers in developing the performance of equipment to its present day level.

From this discussion it is hoped that sufficient emphasis has been put on the requirements of the application as the final deciding factor in the selection of the proper bearing. The designer is capable of providing for either type and if the manufacturing facilities are set up to handle the close machining tolerances required for precision bearing mountings and to prevent contamination during assembly, there should be no difficulty in operating a machine with either type. The present day performance of machine tools in general is adequate proof that you men have successfully worked out many a complicated bearing problem which should provide the basis for much more interesting discussion than theoretical observations.

For FASTER PRODUCTION- ACCURATELY, ECONOMICALLY!



The famous Davis Micrometer Type Boring Bar, pictured above, will introduce new standards of efficiency and economy into your plant.

Operation at maximum efficiency is assured by quick, accurate Micrometer adjustment of cutters for size.

Made in multiples for line boring, this accurate tool is designed for successful use on any rough, semi-finish or finish boring operations.

Send us prints of your work for a specific, money-saving recommendation. No obligation. Write us today.

DAVIS BORING TOOLS

DAVIS BORING TOOL DIVISION
Larkin Packer Co., Inc., St. Louis, U.S.A.

BEHIND THE SCENES

(Continued from page 21)

ing equipment.

2. Turret lathe and screw machine multiple tool set-ups.

3. Grinding cylindrical, external and internal surface and centerless equipment.

4. Honing fixture equipment.

5. Broaching in all its varieties, this highly specialized line offers immeasurable scope of possibilities.

6. Precision Diamond and Tungsten boring machines and fixture equipment.

Group D. This group deals with heat treatment problems and possibly produces more headaches than any other single line of endeavor. Carburizing, quenching and straightening equipment and some furnace design.

Group E. All perishable cutting tools. This group works in conjunction and cooperation with the many vendors in the cutting tool line in an endeavor to standardize and maintain uniformity of practice. In fact, it is a field of endeavor all its own.

Group F. This select group serves the inspection department, with a multiplicity of ingenius special gauging and checking devices. The actual development of these designs requires a somewhat different approach than do production tools.

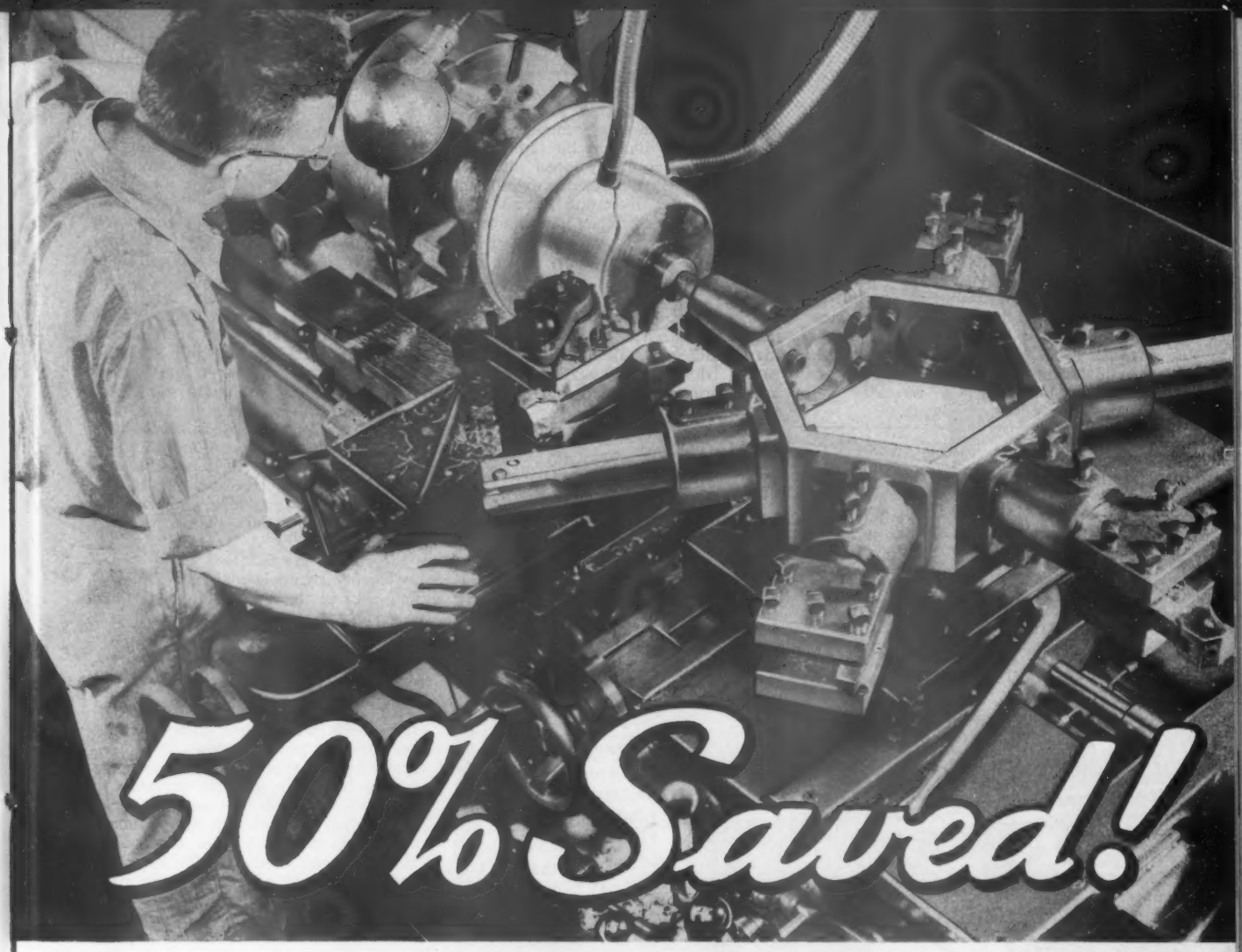
Also assembly line and sub-assembly tools to facilitate easy and quick assembly. This field calls for unique practice and definite study.

In addition, personnel capable of handling the design of special or single purpose machines must be maintained.

Now in essence special machines are simply standard principles and processes arranged in a special or particular way to meet off-standard conditions. Every factor used in an analysis study of a small tool must be considered also in a large machine tool.

However, greater knowledge, skill, ability, and experience on the part of the designer is required to meet the purely engineering problems machine construction presents—weight distribution, torque, thrust loads, gearing, mechanical efficiency, hydraulic and electrical applications, bearing arrangements, lubrications, coupled with a thorough knowledge and if possible, actual experience in the technique of the processing function the machine under consideration is intended to perform whether it be drilling, reaming,

(Continued on page 44)



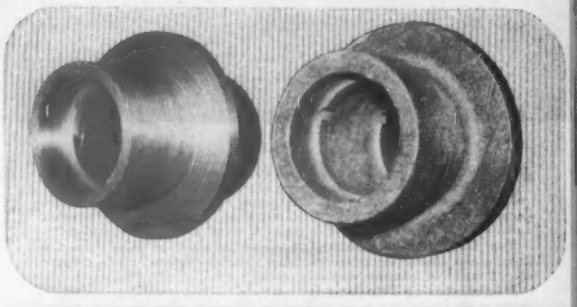
—with the aid of the GISHOLT CROSS-FEEDING TURRET

● This manufacturer not only cut his cost 50%, but obtained greater accuracy by using the Gisholt 2L High Production Turret Lathe with cross-feeding turret to make these wheel hubs.

With the Gisholt cross-feeding turret, facing cuts are made by merely feeding the turret across the face of the work. In many cases two operations are done at the same time, as, for example, boring with the cross-feeding turret while turning with the cross slide or square turret. Furthermore, by setting the turret off center to obtain the correct diameter, boring cuts are taken with single point tools, and on several dimensions tolerances are held to within a half-thousandth.

There are many ways these new Gisholts can cut your machining costs. A Gisholt engineer will be glad to point them out for you. Ask him to call.

"YOUR SMARTEST INVESTMENT TODAY—BETTER MACHINE TOOLS"



WHEEL HUB HOUSINGS FOR ROLLER BEARINGS

★ *Machining these parts in half the former time was made possible with the Gisholt cross-feeding hexagon turret, Gisholt's accurate hardened steel ways, and Gisholt standard tools.*

Literature on the latest types of Gisholt machines sent upon request.

GISHOLT

GISHOLT MACHINE COMPANY

1229 EAST WASHINGTON AVENUE, MADISON, WISCONSIN, U.S.A.

TURRET LATHES • AUTOMATIC LATHES • TOOL GRINDERS • BALANCING MACHINES

BEHIND THE SCENES

(Continued from page 42)

milling, boring, broaching or grinding, etc.

Such knowledge avoids delay on the drawing board, eliminates costly experimentation, and redesign and facilitates fast and ease of machining, construction and assembly in the tool building department.

Last in the designing group, but by no means the least, are the checkers.

These men are recruited from the ranks of the designers and possess an intimate knowledge of company methods and practices, and operates with broad discretionary powers.

They are the inspector type and true to their kind are tough to get along with sometimes. However, they virtually form the last ditch to be jumped by some of the "squirrely ideas" that persist in creeping into designs even in the best regulated designing rooms. Also of importance is the fact that this group answers only to myself, and consequently are relieved of any group supervision influence.

Also the nerve center of the group is the record department, covering all the routine business of issuing tool identification numbers and recording same. Tool work order follow-up and a vast print and tool tracing filing system.

In general make-up this entire group is a business within a business, however, we produce nothing that shows on the revenue side of the ledger, we are a cost and I am sure, to many company banker officials "a necessary evil," nevertheless, as previously mentioned, the advance forward doing things better and differently will only be as fast as we machine Tool Engineers can devise ways and means to do the job more profitably.

No doubt the question arises in the mind of many as to why such an expensive tool designing and building layout is necessary when the tooling market offers such a wide variety of specialized tool service.

The truth is, we do avail ourselves of everything the machine tool industry has to offer wherever it is possible and profitable to use. However, many factors enter into the picture when viewed from our particular standpoint and needs.

Of note is the fact that while a tractor closely parallels many of the characteristics of the automobile, it is also noticeably larger, more massive, and actually in many essential features produced to closer manufacturing limits.

In view of the fact that practically all machine tools and accessories are built to meet the automotive industry's needs where they naturally find their greatest potential sales, they consequently fall short in many instances both as to size, mass, and accuracy to meet our manufacturing need.

To properly appreciate the situation, one must understand the differences between mass production in the automotive field where large quantity runs on yearly schedules are produced, rarely subject to interruption by changes affecting the component parts of the automobile, whereas, in this heavier automotive or tractor manufacturing, production lots are smaller and parts are larger and to a definite extent more exacting.

Also of note is the absence of yearly models in our product, but in its stead a continual process of improvements to meet the ever widening sphere of activity and varied and grueling tasks the tractors are called upon to perform. So in order to maintain manufacturing costs at a profitable level and prevent a vast build-up of avoidable capital investment in machinery and buildings, a much different approach must be made than generally prevails in the motor plants.

Precision and interchangeability must be maintained, nevertheless, tear-downs and set-ups must be continually made to permit rapid change-overs from one part to another to insure profitable production burdens on every available machine tool, because machines cannot earn money and profits standing still occupying valuable space in the plant layout.

This difference therefore calls for special treatment of our tooling problems, introducing problems of registering and

(Continued on page 46)

1" Collet Capacity 9-inch Swing South Bend Underneath Belt Motor Drive Quick Change Gear Tool Room Precision Lathe. Mounted on all steel welded bench. ½ H. P. instant reversing ball bearing motor and 12-speed drive are enclosed in left side of bench.

THIS new 1" collet capacity 9-inch swing back-geared, screw-cutting lathe has the time saving features of an engine lathe combined with the sensitivity and accuracy of a fine precision collet lathe. It is capable of the most exacting tool and instrument work, and has the power and rigidity for taking heavy cuts on high speed production operations.

Tool Room Attachments as illustrated include hand wheel draw-in collet chuck attachment, telescopic taper attachment, micrometer carriage stop, thread dial indicator, and collet rack.

Manufacturing Attachments available include hand lever draw-in collet chuck attachment, semi-automatic hand lever bed turret, double tool rest, automatic carriage stop, four-way tool post turret, oil pump, piping.

Immediate Delivery can be made on all popular sizes of South Bend Lathes from dealer display stocks in principal cities; a few are listed below.

68 Sizes and Types of Lathes

9", 11", 13", 14½", and 16" Swing.
3' to 12' Bed Lengths.
Countershaft Drive.
Motor Drive.

16" x 6' Underneath Belt Motor Drive Lathe

Send for Illustrated Catalog

ON DISPLAY IN PRINCIPAL CITIES

Boston, Mass. — The MacKenzie Machinery Company
Buffalo, N. Y. — J. L. Osgood Machinery & Tool Co.
Chicago, Illinois — C. B. Burns Machinery Company
Cleveland, Ohio — Reynolds Machinery Company
Detroit, Michigan — Lee Machinery Company, Inc.
Los Angeles, Calif. — Eccles & Davies Machinery Co.
Milwaukee, Wis. — W. A. Voell Machinery Company
Newark, N. J. — I. B. Edwards Machinery Company
New York, N. Y. — A. C. Colby Machinery Company
Philadelphia, Pa. — W. B. Repp, Machinery
Providence, R. I. — Geo. T. Reynolds & Son, Inc.
San Francisco, Calif. — Moore Machinery Company
Seattle, Washington — Star Machinery Company

SOUTH BEND

SOUTH BEND LATHE WORKS

Lathe Builders Since 1906 — 927 E. Madison St., South Bend, Indiana, U. S. A.

No. 26

SPECIFICATIONS—Table: 50" x 12"

The swiveling cutterhead . . . sliding ram . . . front and rear controls . . . 6-way rapid traverse . . . greater selection and range of feeds and speeds . . . greater rigidity . . . extreme accuracy . . . and many other features of the *new* No. 26 Van Norman Universal Miller, all combine to reduce overall completion time of work milled, and cut your costs. Write for Bulletin.

VAN NORMAN

MACHINE TOOL CO., SPRINGFIELD, MASS.

BEHIND THE SCENES

(Continued from page 44)

locating and adaptability, and easy quick and accurate changeover, whereas in the long run layouts as performed in the automotive field, once the bugs have been removed from the tools, only maintenance is left until the next major yearly change is made.

Looking over the various phases of tooling necessary to produce and maintain supremacy in the tractor field, one could dwell at length on almost any particular line and find many interesting avenues of discussion.

Picking at random for instance, the inspection department phase of tooling activity. In this particular line one must find men who are able to approach this problem totally different from production problems.

In this field one finds a vast and almost limitless domain that calls for keen perception and clear analysis because accurate and effective inspection control of any manufactured product are the arteries through which the life blood and sustained existence of any manufactured product flows.

The inspection departments in any plant are usually the guardians of reputations for quality, and for this task the tool design department must keep itself abreast of the times as to methods and practices to effectively assist in this enormous and exacting task.

With the tractor completed and sliding off the end of our up-to-the-minute assembly lines, and well on its way to a proud dealer and satisfied customer, the tool design finds itself confronted with the problem of assisting in keeping the tractor in a healthy condition during its long span of years of usefulness. To this task the service department have dedicated themselves, but a highly specialized product like a Diesel tractor requires special service tools.

In conjunction with the service department, another approach must be made, because high up in the Andes, in the swamp of the south, in the frozen plains of the north lands, and in the sun blistered expanses of South Africa, "precision servicing" must be maintained without the aid of a "precision factory" not even a way side garage at times. But such is the romantic task service departments are doing every day, and remember the sun never sets on tractors at work, in every corner of the world, civilized or otherwise, pushing back frontiers and removing barriers that have confounded the efforts of man since time immemorial. But again, tools and the experience and resources of the tool design department play a very definite part in this work.

All of which calls for something more than ability, it calls for imagination, because ability without keen imagination is like Romeo without Juliet or better still, Irish stew without the onions.

Undoubtedly, many of you are pondering in your mind just where do we find such men with so broad a knowledge—well truthfully, we don't find them. In fact, the average tool designer available on the market today rarely has a competent working knowledge of more than three or four lines.

However, the other qualifications being satisfactory, we feel that it is best, because tool design methods vary considerable from one firm to another. This fact is responsible for the absence of any really worth while work on the market which can serve as a text book for student guidance, a few basic fundamentals at best is all they offer.

It should be noted when a tool design department reaches large proportions it usually resembles in make-up, that of any large product engineering designing group. Individualism is somewhat submerged in view of the fact that often more than one man contributes to the actual design, and still more, when the assembly drawing breakdown begins, and starts the detailers to work, many notable contributions are often made, by bringing to light oversights on the part of the designer not readily noticeable on the general arrangement drawing.

It is the supervision's greatest function because of their more intimate knowledge of the management's desires, to be able to separate the chaff from the wheat in the crop of ideas that spring up from every direction by the various people assigned to jobs. This I find is more important than the leads the supervisor must naturally furnish in arranging his work for the designers.

No man can possibly have a corner

(Continued on page 50)

TO LENGTHEN
GRINDING WHEEL LIFE
INVESTIGATE
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Liquid Grinding Compound
NEW — DIFFERENT — BETTER
Recommended by nearly all grinding machine and grinding wheel makers. Phone or write today for Free Working Sample and 24 page "CODOL" booklet.
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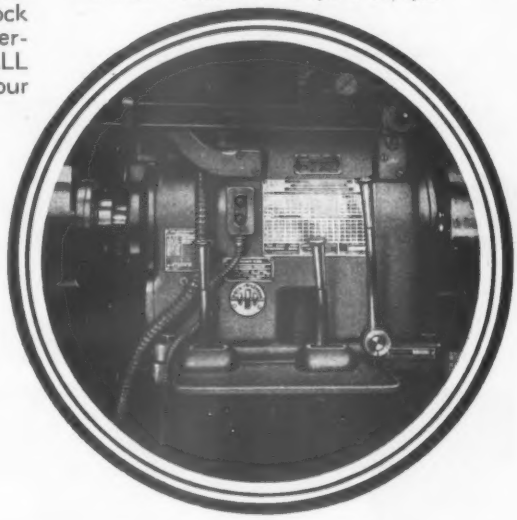
FEATURES OF P&J POWER-FLEX CONSTRUCTION

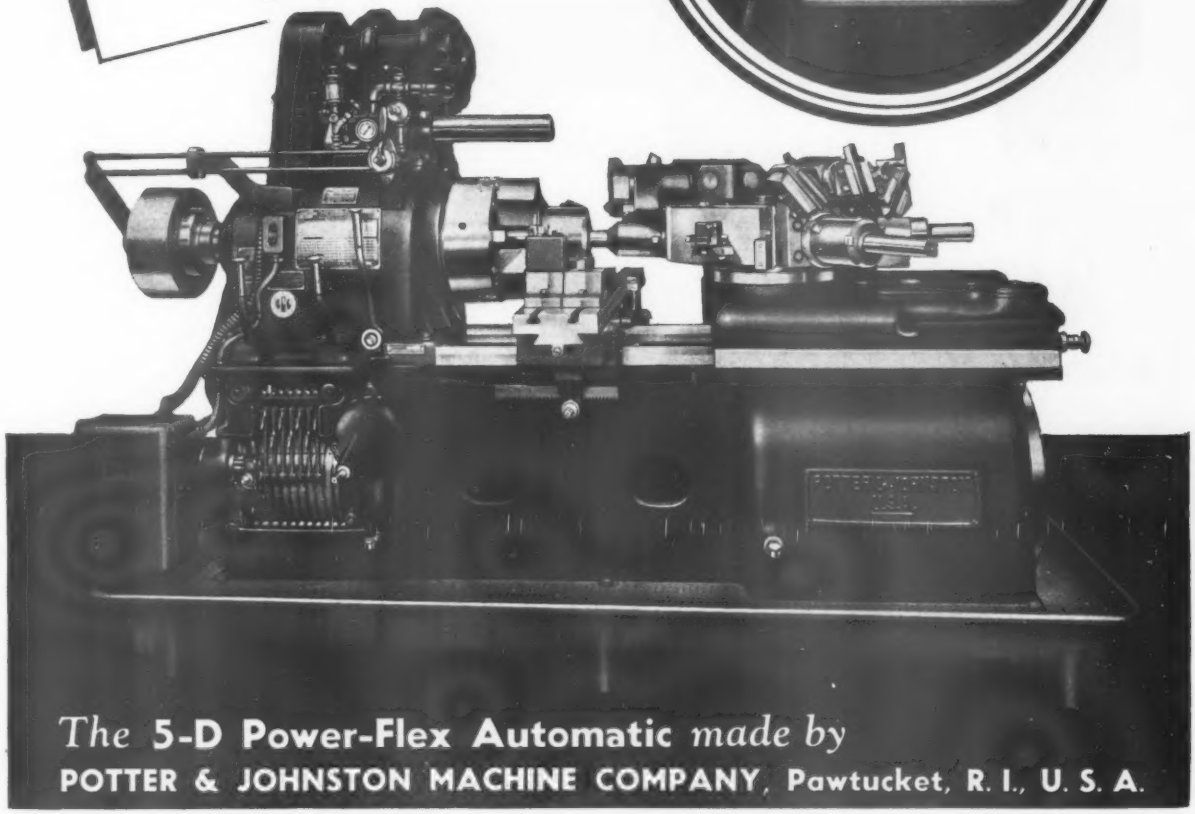
For the 5-D Automatic Chucking and Turning Machine

A NUMBER of distinctive P & J Construction Features has accounted for the success and popularity of the 5-D Power-flex—has resulted in a flexibility and a versatility not obtained with ordinary equipment—has boosted output and promoted the division of labor costs! One of these distinctive P & J Features is illustrated here—the Headstock Unit. Others, equally important, will appear in future advertisements. For full particulars, for an understanding of ALL P & J advantages, see the newly published Bulletin 108. Your copy mailed upon request.

In the insert below is a close-up of the Headstock Unit, in which the Spindle is made from a high carbon steel forging. All shafts are of alloy steel heat treated. Spindle and shafts on Timken Tapered Roller Bearings. Gearing of heat treated chrome nickel steel, spiral form teeth. 20 speed changes between 16 and 304 rpm, arranged in 5 sets of 4 automatic changes. Special models available with maximum speeds of 443 rpm or 610 rpm.



THE HEADSTOCK UNIT



The **5-D Power-Flex Automatic** *made by*

POTTER & JOHNSTON MACHINE COMPANY, Pawtucket, R. I., U. S. A.

FACTORY REPRESENTATIVES: William L. Martin, Headquarters at Factory: New England States and Eastern New York and New Jersey; A. W. Stone, 986 Kenyon Ave., Plainfield, N. J.: Western New York and New Jersey, Eastern Pennsylvania, Maryland and Delaware; G. Tell DuBois, 8-154 General Motors Building, Detroit, Michigan; Michigan and the City of Toledo, Ohio; Louis K. Voelk, 14014 Woodworth Road, East Cleveland, Ohio; Ohio—with the exception of Toledo, and Western Pennsylvania; Harry I. Schuster, 743 N. Fourth Street, Milwaukee, Wisconsin: Illinois, Missouri, Wisconsin, Iowa and Indiana. **AGENCIES:** Star Machinery Company, 1741 First Street, South Seattle, Washington; Henes-Morgan Machinery Co., 2026 Santa Fe Ave., Los Angeles, Calif.; Jenison Machinery Co., 20th and Tennessee Streets, San Francisco; Wessendorff, Nelms & Co., Inc., 320 Franklin Ave., Houston, Tex.; Arthur Jackson Machine Tool Co., 60 Front Street, West, Toronto 2, Ontario; Arthur Jackson Machine Tool Co., 437 Grosvenor Ave., Montreal, Canada; Burton Griffiths & Co., Ltd., Birmingham, England; R. S. Stokvis et Fils, Paris, France; Rotterdam, Holland and Brussels, Belgium; Maskinaktiebolaget Karlebo, Stockholm 1, Sweden; Ing. Ercole Vaghi, Milano, Italy; Yamatake & Co., Ltd., Tokyo, Japan; (Imperial Export Co., 44 Whitehall Street, New York, N. Y.); Almacoa, Zurich, Switzerland.

LOOKING AROUND

By Perry Scope

IN ANY plant that employs Tool Engineers there is probably no one job that requires so complex, and so complete a knowledge of its products, its methods, its personnel, and their personalities as the job of the Tool Engineer. This publication is dedicated to making easier his difficult task. This column is the first in a series designed to warn against pitfalls, obstructions, wash-outs, etc., and some of the detours along the road he should travel that experience has proved to be the best.

The personnel he must consider are:

The Designer of the product:

His objective is service to mankind.

His Needs: Ideas and cooperation.

Chief of Time Study:

Objective: To save time, stop losses, reduce costs, and be fair to all concerned.

Needs: A thorough knowledge of shop practice and short cuts. He should have a well greased slide rule and must know mathematics.

Chief of Estimating:

Objective: Establish the best price for the Tool and know it will produce per estimate.

Needs: Tools, Their Disposition, Proper Handling.

Production Superintendent:

Objective: Tools that produce accurately with no down time. Tools that stay in use and not stay in the Crib.

Needs: Maximum output from minimum tool and equipment layout.

Chief Inspector: To ascertain if the tool is according to specifications.

Objective: Will the tool produce a uniform product?

Needs: Ability to check and measure, and the best possible measuring equipment. Good judgment and ability to read drawings.

Tool Room Foreman:

Objective: Produce as specified for as little as possible.

Needs: Clear specifications and Good Tool-Makers, Materials and Equipment.

Tool Maker:

Objective: To make what is specified.

Needs: Ample, clear information, and Good Tools and Materials.

Workman:

Objective: To make as good a living as easily as possible. He is the final court of approval, and he'll find plenty of weaknesses and short cuts.

Do you ever go down in the shop to see what improvements he has made on your work and suggestions? No? You'll be surprised.

There are other men, too, whose objectives and needs are important to you such as your metallurgist.

You are a Tool Engineer—Do you help these men attain their Objectives? Easily?

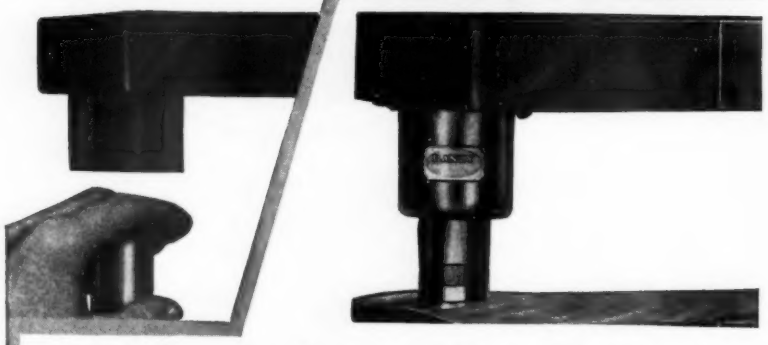
Do you help these men obtain their Needs? Regularly? If you can answer Yes! Then you are a TOOL ENGINEER.

Perry Scope

Remember: A stitch in time saves embarrassment. P.S. Next Issue: When is a Tool necessary?

DANGER AHEAD

Safe



with Danly Safety Guide Post Covers

Most press accidents today are pure accidents; and in cases where the bushing leaves the guide post, the resulting gap is a source of danger.

Some worker places a hand or arm between the bushing and the post, when the press is down or power is off. When the press is started, serious injury results. Also carelessness or slips in handling get the stock between guide post and bushing, resulting in a "wreck" of die, die set or press—piling up expense and crippling production.

These *"didn't know it was loaded"* types of accidents are the most difficult to prevent—but Danly Safety Guide Post Covers applied to all dies where the bushing leaves the post are a low cost way of providing automatic insurance against them. They cover the gap so that nothing can enter; and they can also be equipped with oilers for positive lubrication.

A new folder "Danger Ahead" fully describes Danly Safety Guide Post Covers and their uses. Send for your copy today.

DANLY MACHINE SPECIALTIES, Inc. • 2112 So. 52nd Ave., Chicago, Ill.

DANLY DIE SETS AND DIE MAKERS' SUPPLIES FROM THE 9 DANLY BRANCH STOCKS

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DUCOMMUN
Metals and Supply Co.
Los Angeles—San Francisco

DANLY DIE SETS and DIE MAKERS' SUPPLIES

"ELEMENTS IN TOOL DESIGNING"
(Continued from page 21)

18—PATTERNS AND CASTINGS

vs.

FABRICATED STEEL WELDED CONSTRUCTION

Does the design lend itself to good pattern making practice and economical castings?
Would steel construction offer any advantages?

19—TOOL STEELS AND ALLOYS

Have the proper steels been selected to make the miscellaneous details?

20—SAFETY

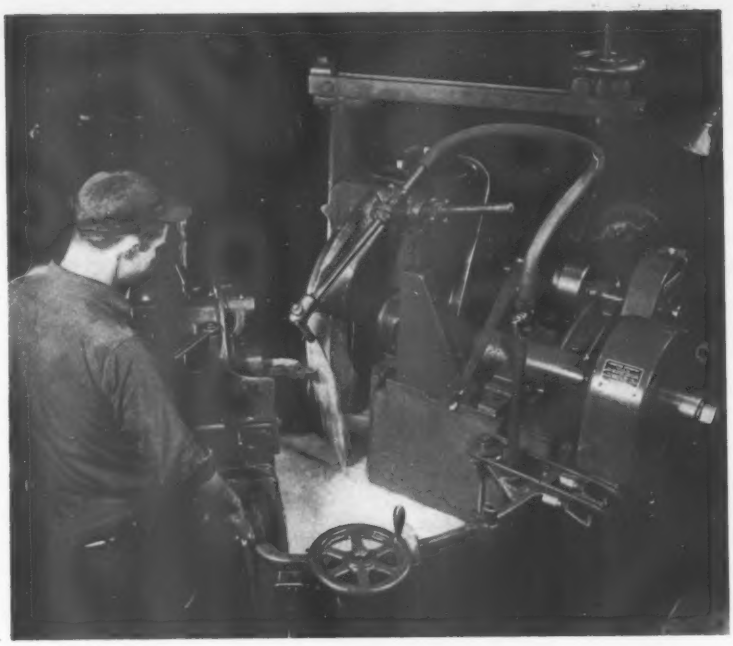
(a) Will finished tool be safe to operate?
(b) Has any new accident hazard been created?
(c) Can danger be offset or eliminated? Remember "only a safe tool is a good tool."

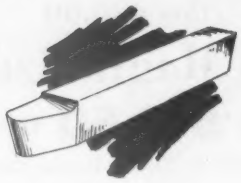
21—DRAWING PRACTICE

Does the finished drawing conform to company practice and standards?
Does the "picture tell the whole story?"

22—TOOL RECORDS

Has the tool records file been carefully set up and adequately cross filed for future reference?



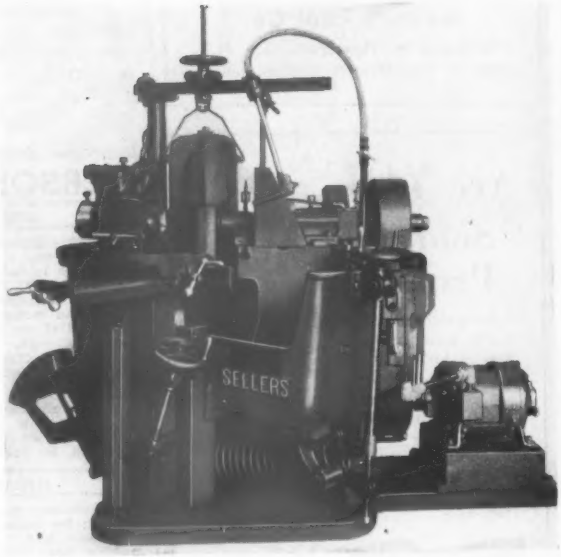


How your tool room attendant can step up production

IN THESE DAYS every productive employee counts — but only while on productive work. Do you know how much of your machinists' time is spent on tool grinding? The figures may surprise you.

Why continue? An expensive machine stands idle . . . production is held up! Yet your tool room attendant can do this job. With a Sellers Tool Grinder, he can grind tools more accurately than the best machinist can by hand . . . and in less time. Less tool steel will be wasted and the tools will last longer and cut better. Your machinist can be kept on the work you are paying him to do — and production will not lag.

If you are looking for a way to save money and keep production at peak, we know you will want more information about Sellers Tool Grinders. Write today.



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Made by Sprang Electric Co., Fremont, O.

Complete with Cord and Switch

110-AC—60-Cycle 600-Watt Handle Work Up to 4" Dia. Through Hole

Send Your Orders While Stock Lasts to

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Send for Our Monthly Bargain Bulletin

Are YOU Sold on YOUR Products?

Any product not improved eventually loses its sales appeal.
You make excuses to minimize sales resistance.
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Competition is invited—more sales resistance.
Improve your product and emphasize its sales appeal—"BEARING-IZE."

Bearing-izing is the most economical method known to obtain dimensional accuracy and finish accuracy. Bearing-izing finishes turned, reamed, honed, ground or bored surfaces to a smoothness comparable to that accomplished only by wear.
Modernize your product—"BEARING-IZE."

"HOLE"
ENGINEERING SERVICE
307 Boulevard Bldg.
Detroit **Michigan**

BEHIND THE SCENES

(Continued from page 46)

on all the ideas and they certainly don't grow on trees although many times when it seems we are licked, some one pulls the answer out of thin air.

With this large technical and practical group of men as represented by the tool design department, working under ideal conditions, perfect in light, air conditioned, and quiet, I believe it leaves little to your imagination as to how and where our ideas come from.

I might mention also while on the subject of ideas that regardless of all that can be written and standards of practice that may be established, the man in the shop right down at the point of operation, is one of the greatest and most potential furnishers of ideas and worth while suggestions and if I might be permitted to paraphrase an age old saying and one equally as true, it is "that many an honest-to-goodness idea springs from beneath a tattered suit of overalls."

So in appreciation of that fact, another prerequisite of a good tool designer is an open and receptive mind to all suggestions, regardless of who advances the suggestion, with proper consideration given to them as to their value and possible application.

To accomplish a steady flow of work a routine system must exist, and certain drawing standards followed to lend uniformity to the picture each sheet of drawing produces. This feature is very important because of a large scale building plan many people must interpret the meaning of the prints and naturally a definite uniform procedure in arrangement of view, size of lettering, and phraseology tends to simplify reading and reduce to a minimum the number of calls made upon the tool design to clear up points of doubt which arise in the tool room and often if not passed upon would result in loss of time and valuable material.

It should also be noted that in view of the steady continuity of progressive change and the desire to get every improvement into production as quickly as possible that the time element between engineering releases and production schedule dates seem to grow ever nearer and nearer, therefore, rarely do the tool designers get an opportunity to see the actual piece part while tools are being planned or designed and therefore, it is truly a tribute to the keen imagination of these men how they picture these parts in their minds and fashion the tools around them with only a flat drawing to work from.

It is under circumstances such as these with reference to forgings and particularly production castings that at least an elementary knowledge of pattern making and foundry practice is necessary because we are confronted by the nightmare of where to locate them, how to hold them, where the shifts in cores might occur, and where parting lines will be or whether variations will be so inconsistent as to necessitate special treatment to assist in establishing definite location points.

Well, so much for the designing end of tool engineering. Let us turn now to the group who control the building or making end of the business. As previously stated, it is a necessary qualification of a first class tool designer that he know tool room practices and methods, for while he designs tools for use in production, the actual construction of the tools must be done under vastly different conditions and sometimes entirely foreign to anything of a production nature.

Now it is substantially true that given the necessary time a tool room can make practically anything under the sun—improvised and make-shift set-ups can be arranged, whittling, chipping, scraping, and filing resorted to, machines partially dismantled or stretched to meet necessity, and no end of ingenuity devised to accomplish the near impossible.

But why? Why, simply for the reason that too many would-be Tool Engineers and designers have yet to learn the technique of how things are produced and the possibilities and perhaps more so the limitations tool room machines and tool making equipment can be subjected to.

It is this factor, and one that is rarely considered in the books on tool designing, that prohibits the making of many things. In short, perhaps it may be said that impractical design tran-

(Continued on page 58)

Industrial Relations Committee A.S.T.E.

PERSONAL SERVICE

SITUATIONS WANTED

Thoroughly experienced Tool Engineer available for Detroit and vicinity only. Twenty-four years experience including Tool Supervision, Methods and Equipment Engineering and Process Engineering. Capable of handling special assignments and manufacturing cost reduction. Call TYler 5-0145 or write to American Society of Tool Engineers, 2567 West Grand Boulevard, Detroit, Michigan, for further information and to make appointments.

Experienced Tool Designer seeking employment in Detroit or Central Michigan area. Call TYler 5-0145 or write to American Society of Tool Engineers, 2567 West Grand Boulevard, Detroit, Michigan, for further information.

SITUATIONS AVAILABLE

Manufacturing plant in Hong Kong, China, has opening for toolmaker with technical education or better and experience in designing and making jigs, fixtures and tools for automobile engines and parts. Same company also has opening for experienced shop engineer or foreman with technical education; preferably a man who has had experience in an automobile engine factory as foreman or better. Contact American Society of Tool Engineers, 2567 West Grand Boulevard, Detroit, Michigan, for further information.

Manufacturing company has opening for first-class machine designer for work in Dearborn, Michigan. Write to American Society of Tool Engineers giving complete list of experience.

First-class machine tool designer wanted for manufacturing company in Cincinnati, Ohio. For further information write to American Society of Tool Engineers, 2567 West Grand Blvd., Detroit, Michigan, or telephone TYler 5-0145.

Layout designer with experience on hand screw machines wanted to fill vacancy for well-known manufacturing company in Waterbury, Connecticut. For further information write to American Society of Tool Engineers, 2567 West Grand Blvd., Detroit, Michigan, or phone TYler 5-0145.

Wanted metal cutting Tool Engineer for designing and servicing tools, preferably on broaching. Apply A.S.T.E., Detroit.

"NOW YOU'RE *Talking* MY LANGUAGE!"

THE smart lathe operator knows that he has a partner on a job—that he and his machine produce together as a unit. He knows that he's on a spot if his lathe cannot produce the quality and volume of work that he could turn out on a better machine.

But give him a new Monarch—and you'll see *team work* of the highest caliber—you'll agree that a good man and a good machine make an unbeatable combination.

Make this test today. Tell the man who is trying hard but falling down on the job that he will work on a Monarch lathe from now on. Watch his face light up in a smile of appreciation. Hear him say: "Boss, you're talking my language."

THE MONARCH MACHINE TOOL CO., Sidney, Ohio, U.S.A.

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COVER THE TURNING FIELD

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BRADFORD DRILLING and TAPPING UNITS

Drilling Unit—No. 252

Meet your present high-production demands for drilling, reaming, hollow milling, spot facing, tapping, etc., on one of these units, designed for the express purpose of assembling one or more heads into one machine and mounted at any angle. Made in two types—light duty high speed and heavy duty medium for slow speed and large work, and with motors from ½ to 7½ H.P.

Write for descriptive literature on this and other BRADFORD cost-saving equipment.

THE BRADFORD MACHINE TOOL CO.
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Dealers wanted in some territories.

December Chapter Meetings

Chapter Meeting Announcements must be received on or before the 20th of preceding month to appear on this page. Members and friends of The Society contact Chapter Secretaries for meeting details if your announcement does not appear below.

BALTIMORE

December 11, 1939—Dinner, 7:00 P.M.; Technical Session, 8:00 P.M. Sears Auditorium, North and Harford Ave.

Speaker: Mr. Fred W. Hammer, Representative of the Warner & Swasey Company.

Subject: "New Principles and Developments in Small Tools," Illustrated with Movies.

Reservations: Mr. Stanley S. Johns, 806 Evesham Ave., Baltimore, Maryland, Phone Tuxedo 2127.

BUFFALO-NIAGARA FRONTIER

December 14, 1939—Dinner, 6:30 P.M.; Technical Session, 7:30 P.M. University Club, 546 Delaware Avenue, Buffalo. Members, $1,10; non-members, $1.50.

Speaker: Mr. Burnham Finney, of American Machinist.

CENTRAL PENNSYLVANIA (York)

December 12, 1939—Dinner, 6:30 P.M. West York Inn, West Market Street & Highland Avenue, York, Pa. Meeting 7:30; Technical Session 8:00.

Speaker: Mr. V. H. Ericson, Norton Company.

Subject: "Refined Surface Finishes as Applied to Regrinding of Metal Cutting Tools

Several reels of sound film will be shown as part of the program.

DAYTON

December 8, 1939—Dance Party. See committee for place. Keep date open. Let's go stepping.

December 11, 1939—Dinner, 75c. 6:30 P.M. Regular Meeting. Plant visitation at Inland Mfg. Co.

Speaker: Dale Phillipi.

Subject: "Molding Plastics."

DETROIT

December 14, 1939—6:30 P.M. Club Saks, non-technical meeting. The evenings festivities are: Dinner, musical

(Continued on page 54)

SHELDON

ARBOR PRESSES

In 12 Sizes, from ¾ to 10 ton Pressure Capacities

A complete line of bench and floor presses. SHELDON Arbor Presses are stronger, handier, more versatile presses, correctly designed and accurately machined from quality materials with heat-treated and ground round rams with means for holding accurate alignment, and non-stripping alloy steel gears. 10 sizes, 3 to 10 tons. Simple, compound or wheel levers.

Write for Catalog Sheet.

Sheldon Machine Co. Inc.
1619 N. Kilbourne Ave.
Chicago, U.S.A.

At Last!

A POSITIVE ROLL GRIP KEYLESS

DRILL CHUCK

that fills a long-felt need

Check these advantages:

1.—A chuck that will not let your drills slip.
2—100% keyless.
3—The heavier the load, the tighter it grips.
4—No more drill shanks damaged by chucks.
5—Yes! The tapered shanks are tempered.
6—A slight twist of the wrist releases drill.
7—Scientifically designed—ruggedly constructed.
8—Will run true and remain so during its life.
9—Unconditional one-year guarantee (barring abuse).

A folder giving prices and complete details will be mailed to you just for the asking.

MOTOR TOOL MFG. CO.
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"UTILITY" PNEUMATIC GRINDER

MODEL U.-T.R.

A WORTHY COMPANION TO OUR **FAMOUS** "SUPER-SPEED" MODEL S.S.-SR.

A 60,000 R.P.M. Unit Weighing 2¼ pounds
An Abundance of Power
Steel Housing (for Safety)

Special Grease Sealed Bearings
No Lubrication Required

Adaptor Furnished for Use in Tool Post of Machine for Stationary or Internal Jobs

Other Models, Also Air Line Filters and Automatic Air Line Lubricators
WRITE FOR DETAILS

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"O K" Savings Begin With Your First Installation

The O K System is an investment that begins to write itself off the moment it is installed. Compared with solid tools, the O K Inserted-Blade principle makes an immediate reduction in high speed steel cost. Much time (which is money!) is saved by being able to have spare sets of blades and bits always ready. Also, better work is done by having access to the wide variety of blades and bits shown in the O K catalog, the consistent use of which increases the versatility and ability of your operators.

Adapted to Complete or Gradual Change-Over

The O K line includes milling cutters, end mills, face mills, boring heads, reamers, counter bores, multiple operation set-ups, and single-point tools for lathes, shapers, planers, etc. Everything is here for your complete re-equipment — or, a machine or department at a time may be revised. On this, our engineering department will be glad to co-operate. Catalog on request.

THE O K TOOL COMPANY, SHELTON, CONN., U.S.A.

TRADE O K MARK

INSERTED-BLADE METAL CUTTING

TOOL SYSTEM

T. H. L. FRONT LEVER BENCH PUNCH

PRICE WITH ONE PUNCH AND ONE DIE—

$37.00

Immediate Shipment

Built for hard, tough work — die cannot lose alignment with punch—all parts interchangeable.

Capacity—½" holes through $\frac{3}{16}$" steel; $\frac{13}{32}$" through ¼" steel. Can also be made for holes up to ⅞" in thinner metal. Stock punches and dies available from $\frac{1}{32}$ to ½" by 64ths.

Weight, 70 lbs.

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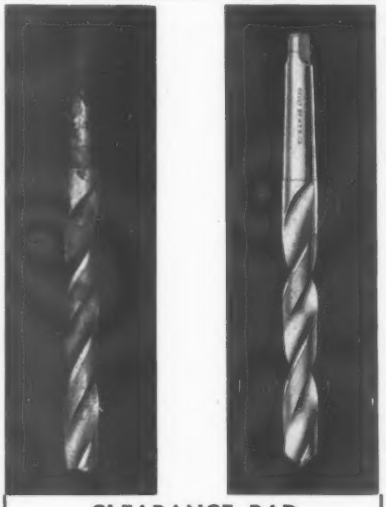
(Est. 1890)

307 E. 47th St. New York



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INACTIVE SIZES

WE CAN HELP YOU TO YOUR PROFIT

National Tool Salvage Co.

DETROIT

Number 3 Set

Everede Boring Bars are the only bars on the market having the economical triangular bit. These bars permit using a larger bar diameter than usual due to the bit cutting ahead of the bar. This design insures rigidity, making higher boring speeds and heavier cuts possible.

Everede Boring Bars are made of the finest heat treated nickel steel and are each furnished with six high speed steel triangular bits.

Everede Boring Bars permit the use of a solid Stellite or carbide tool bit, accomplished by clamping the bit on the "V" Type grip, which holds it firmly without danger of breakage.

Send for descriptive folder.

EVEREDE TOOL CO.

Willis Stutson
184 N. Wacker Drive, Chicago
Representatives in principal cities

DECEMBER MEETINGS

(Continued from page 52)

entertainment, ten turkeys to be given away, a grand door prize, moving pictures, and floor show. $1.75 covers the works.

Reservation: by December 13, call TYler 5-0145.

GOLDEN GATE—OAKLAND & SAN FRANCISCO

December 12, 1939—6:30 P.M. California Hotel, Oakland.
Speaker: Mr. Sam Dows.
Subject: "Dust Control in Industry."

ELMIRA

December 15, 1939—Dinner, 6:30 P.M. Elmira plant of Remington-Rand Company.
Speaker: Mr. Burnham Finney, of American Machinist.

MILWAUKEE

December 14, 1939—Dinner, 6:30 P.M. Republican Hotel, Colonial Room.
Speaker: Mr. John Haydock of American Machinist.
Subject: "Trends in Machine Tool Design and Use."

NEW YORK—NEW JERSEY

December 12, 1939—Dinner, 6:30 P.M.; Meeting 8:00 P.M. Hotel Robert Treat, Newark, N.J.
Speaker: Mr. Raymond V. Havican, Scoville Mfg. Co.
Subject: "Motion Study Applied to Jig and Fixture Design."
Reservation: Ben Brosheer, Medallion 3-0700.

ONTARIO

December 15, 1939—Toronto.
Speaker: Mr. W. K. Bailey of Warner & Swasey Co.
Subject: "Turret Lathes and Telescopes."

PHILADELPHIA

December 13, 1939—Dinner, 6:30 P.M., Engineers Club. Following this President Jim Weaver will give a short talk.
Speaker: Mr. William H. Oldacre, Director of Engineering & Research, D. A. Stuart Oil Company.
Subject: "Metal Working Lubricants."
Reservations: Make with John Noble, William Sellers Company, Philadelphia.

(Continued on page 56)

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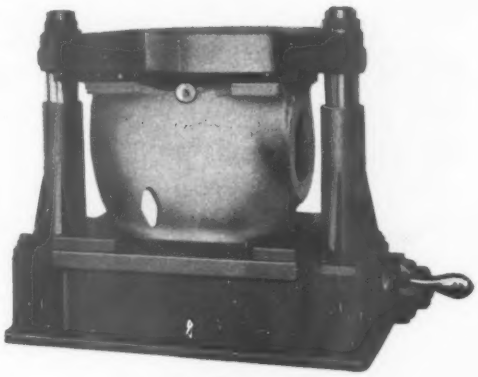

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Toledo—J. W. Mull, Jr.
Philadelphia, Pa.—Morgan Tool & Equipment Co.

December Meetings

(Continued from page 54)

PITTSBURGH

December 8, 1939—Dinner, 6:30 P.M., $1.25 per person. McCann's Dining Room, Ferry & Diamond Street, Pittsburgh, Pa.

Meeting: 8:00 P.M.
Speaker: Mr. F. D. Bowman, Carborundum Company.
Subject: "Abrasives, Their Use and Manufacture."
Your secretary will appreciate the prompt return of all cards.

SPECIAL

Second Annual Christmas Party—December 15, 1939. Bring your prospective member.

ROCHESTER

December 13, 1939—Dinner, 6:45. Todd Union. Technical meeting, 7:45, Lower Strong Auditorium, River Campus, University of Rochester.

Speaker: Mr. Burnham Finney, of American Machinist.
The Rochester Chapter of the American Society for Metals will be our meeting guests this evening.
Reservations: Make reservations by regular member return card, or non-members by calling Stone 2893.

ROCKFORD

December 7, 1939—Faust Hotel, Education exhibits, 5:00 P. M. to Midnight. Dinner—6:20 P.M.

Speaker: Mr. John Haydock, of American Machinist.
Subject: "Trends in Machine Tool Design and Use."

ST. LOUIS

December 14, 1939—Marquette Hotel.

Speaker: R. A. Shartle, Hydraulic Engineer, Vickers, Inc.
Subject: Informal talk on Application of Hydraulics to Machine Tools.
Christmas Party immediately after meeting is adjourned.

SCHENECTADY

December 11, 1939—Dinner, 6:30 (turkey), assessment $1.00. Danish Hall, 989 Albany St., Schenectady. Technical session, 8:00, same place.

Speaker: Mr. Burnham Finney, of American Machinist.
Subject: "A War—How It Affects Your Job."
Members and friends are welcome.

SOUTH BEND

December 14, 1939—Dinner, 7:00 P.M. Oliver Hotel. Technical Session, 8:00 P.M. Speaker and subject to be announced later.

SYRACUSE

December 12, 1939—Dinner, Syracuse Industrial Club.

Speaker: Mr. D. A. Rogers of the Dayton Rogers Manufacturing Company.
Subject: "Economical Production of Metal Stampings in Small Lots."

TRI-CITY

December 6, 1939—Dinner, 6:30 P.M., Blackhawk Hotel, Davenport. Technical Session, 8:00.

Speaker: Mr. John Haydock, of American Machinist.
Subject: "Trends in Machine Tool Design and Use." Illustrated with stereopticon slides.

TWIN CITY

December 13, 1939—6:30 P.M. Dunwoody Institute.

Speaker: Mr. John Haydock, of American Machinist.
Subject: "Modern Trends in Machine Tool Design."

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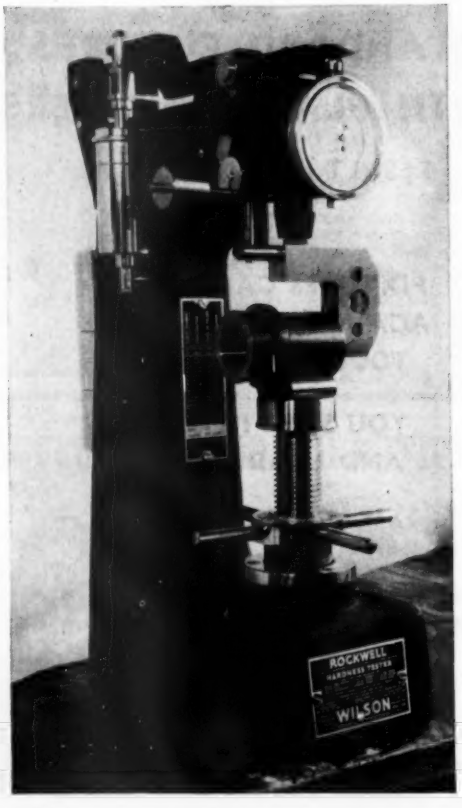

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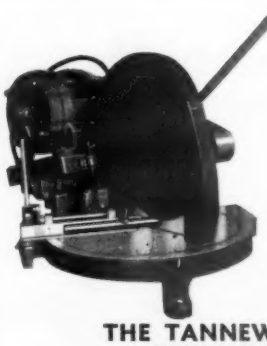

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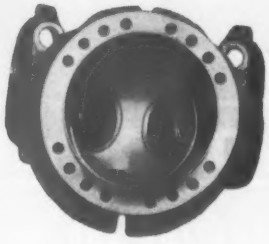

Dependability in the air is the result of accurate dependable work in the aircraft manufacturing plants on the ground. Illustrated is a NATCO Vertical HOLESTEEL Multi-driller, which is being used by an airplane engine manufacturer for drilling the 16 bolt holes in the steel cylinder mounting flange of the cylinder and head assemblies also shown. Production is 60 parts per hour.

This machine, a No. 4 NATCO HOLESTEEL Vertical Multi-driller, is arranged with a 22″ x 38″ rectangular adjustable joint driven head complete with a NATCO slip spindle plate and 16 NATCO slip type spindles. In addition to providing very accurate work, this type of head construction permits a low cost "change-over" should the operations be changed at some future date.

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DRILLING, BORING and TAPPING MACHINES

SOLVES YOUR "HOLE" PROBLEM

BEHIND THE SCENES

(Continued from page 50)

scends feasibility of idea, a better knowledge therefore of "making technique" would most times sell it.

Speaking generally from a Tool Engineer's standpoint I feel that even product designers suffer from the same disease at times.

Now just to be sure I haven't slighted anyone, I might call attention to the malady which affects another branch of the great tooling family. I refer to the "selling Tool Engineer." It is the mistake of over-selling his ware with extravagant claims and which fail and fall short in actual test. Having been on the receiving end for many years, I have come to classify this fault in the same category as the designers who simply don't know and in effect is as damaging as the poorly designed tools which floor the tool makers in their attempt to make them, and often exacts a heavy toll on the reputation of the company that sells them.

Now it does not necessarily follow as some of those "ambassadors of good tooling" would try to make us believe that because they have a tool or a machine which successfully accomplishes a particular tricky operation on a cylinder block, a connecting rod, or a flywheel in the automobile field that it is the answer to our problem. Just because we produce parts which of necessity carry the same name does not indicate we are referring to the same thing. By comparison, one looks very much like a model of the other, and speaking of models always reminds me of the woman who became tired of listening to her neighbor lady continually referring to her "better half" as a model husband. Checking up on the word "model" she discovered it meant simply "a small representation of the real."

Therefore, particularly in the tractor Diesel engine, it is the factors of size, weight, hardness of material and accuracy and relatively low production that generally make the difference.

As a cure for the trouble I would recommend closer analysis study to gain a better appreciation of the facts and requirements.

Happily I am referring to the exception rather than the rule and we certainly welcome and appreciate the counsel these men with the traveling perspective have to offer, and much of the existing uniformity of methods and standards of practices must be attributed to their work throughout the industry.

Again getting back to the designing end of the business and having more or less established the fact that what kind of tools can be designed and made depends greatly upon what facilities are available to build them. To really do a good job, experienced mechanics and tool makers, and modern machine tools must exist, and as I have said before and really a point I cannot emphasize too much is the knowledge of these things possessed by the tool designers.

We tool designers at "Caterpillar" are fortunate in this respect for behind us, and at our disposal, is one of the finest tool building layouts in the country, and therefore when occasion demands it we can practically go the limit in the tool designing art.

Moreover, because of the absence of yearly models, we do not suffer from any noticeable labor turn-over among our tool designers and therefore benefit from the experience of men of long standing, and naturally their continued familiarity with company practices and manufacturing technique.

There is another thought I would like to leave with you and that is with regards to safety in industry. Every year industry pays an enormous toll in accident compensation and accident prevention equipment. Therefore, in designing of tools and machine equipment it is not sufficient that good tools be devised, but "safe tools" even to the extent of sacrificing to a marked degree their possible productive efficiency. To this end sufficient thought and care should be given in an endeavor to anticipate the hazards the new tool has created and consideration given towards the elimination of such conditions.

I presume you have sensed the seriousness of this tool business and the responsibility we believe is ours in relation to the general progress and advancement of the manufacturing industry as a whole.

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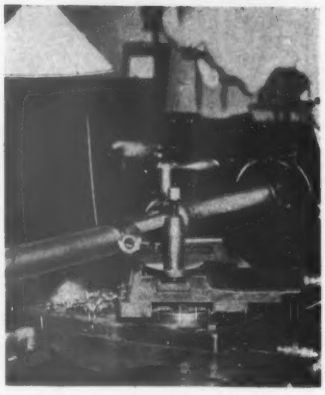

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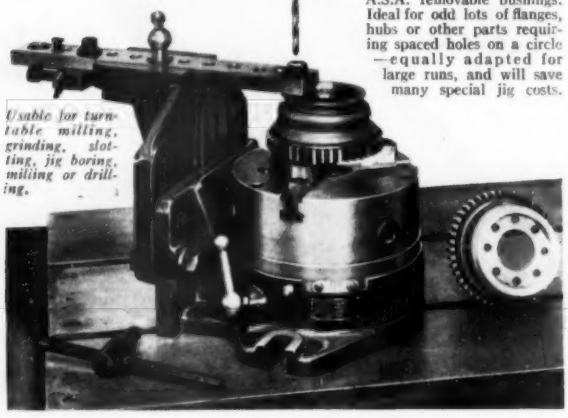

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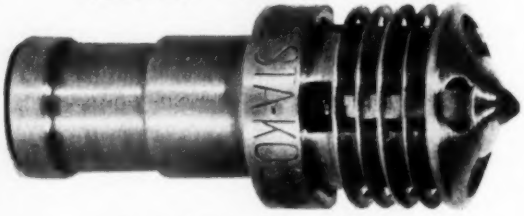

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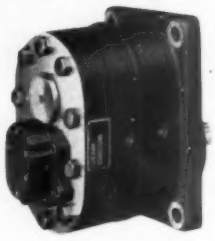

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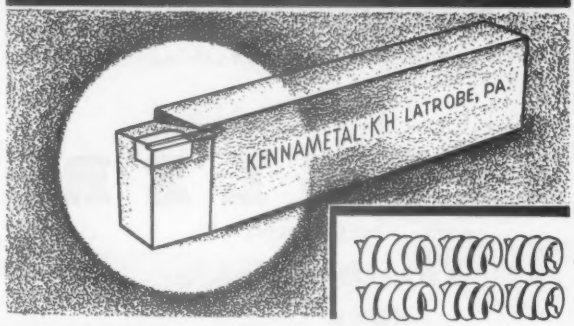

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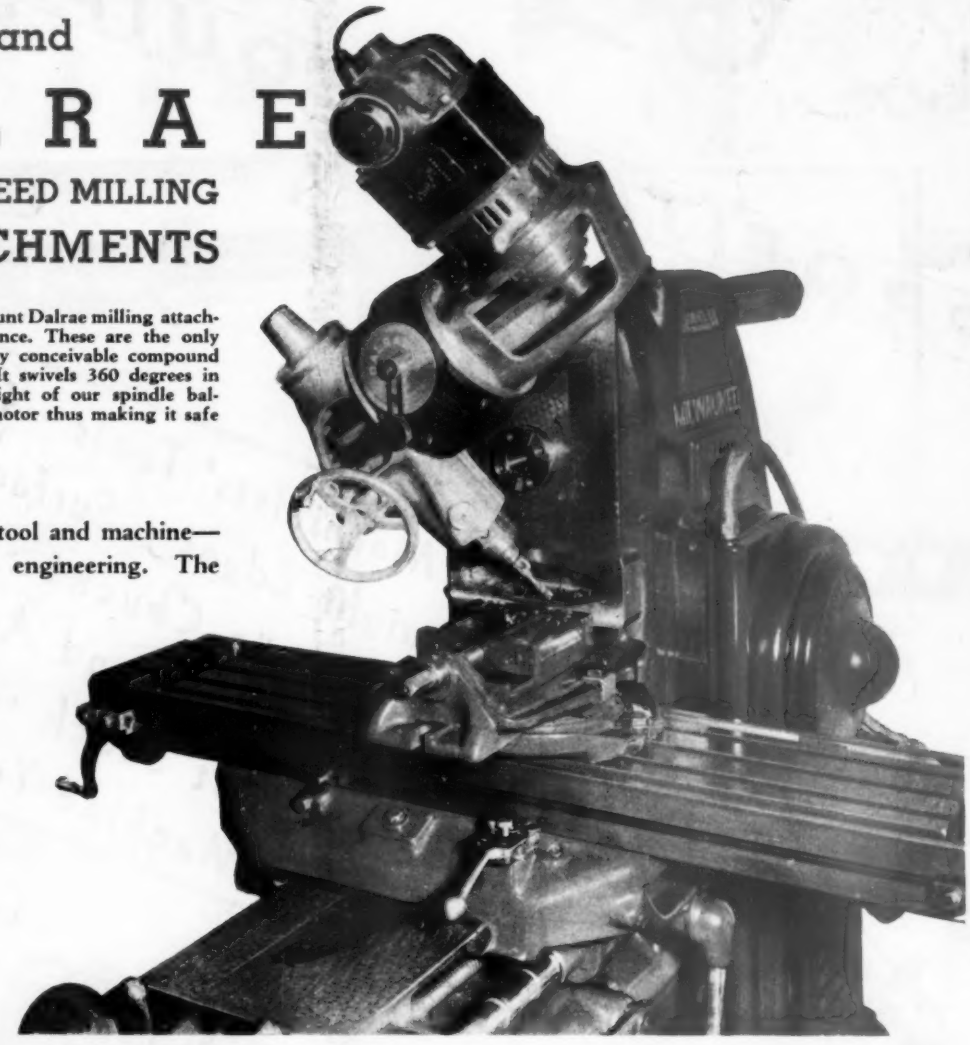
It is only necessary to mount Dalrae milling attachments on the overarm once. These are the only attachments on which any conceivable compound angle can be obtained. It swivels 360 degrees in either direction. The weight of our spindle balances the weight of the motor thus making it safe when mounting.



Get the most from tool and machine—for successful tool engineering. The Dalrae Midgetmill is especially designed to get the most from small tools by providing the correct high speeds they need for most efficient operation. Attach the Midgetmill to the overarm and get the correct high speeds that mean smooth, clean, accurate work and long tool life. Of paricular advantage is the "Thou-Meter," which gives a continuous reading in thousandths of the depth at which you are working—as described and illustrated at right.

Close-up of the "Thou-Meter," showing a setting of exactly 2.500". To use the "Thou-Meter," merely touch tool to work, set dial at zero, and mill, drill and bore until dial shows correct reading—in thousandths. The "Thou-Meter" is accurate to ±.00025" in its 2½" of travel.

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